Electrical World

DECEMBER 27, 1941

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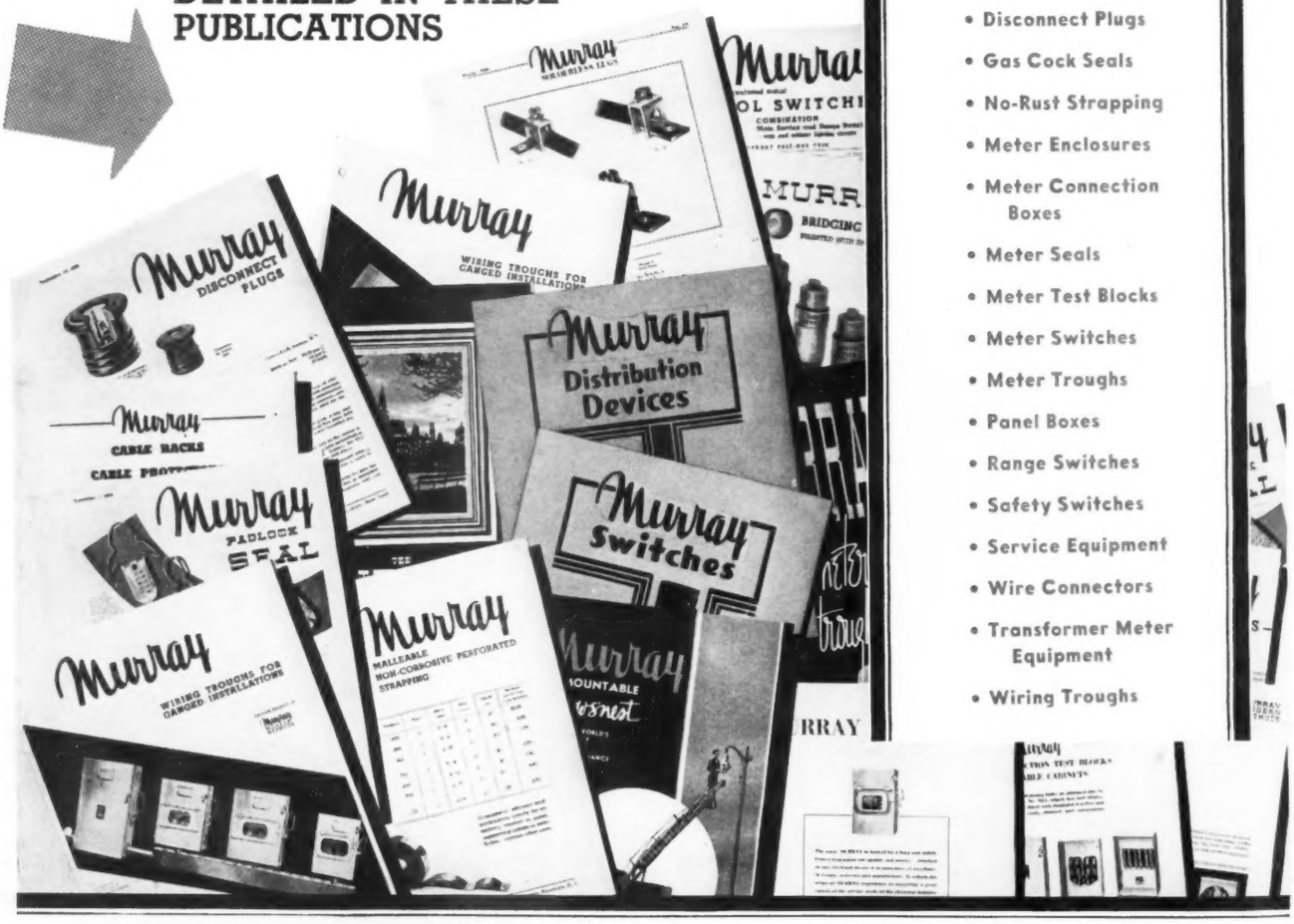

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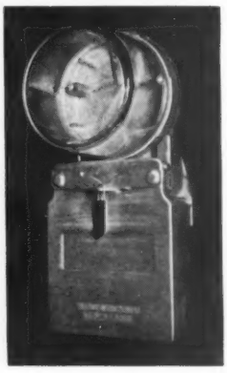

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December 27, 1941

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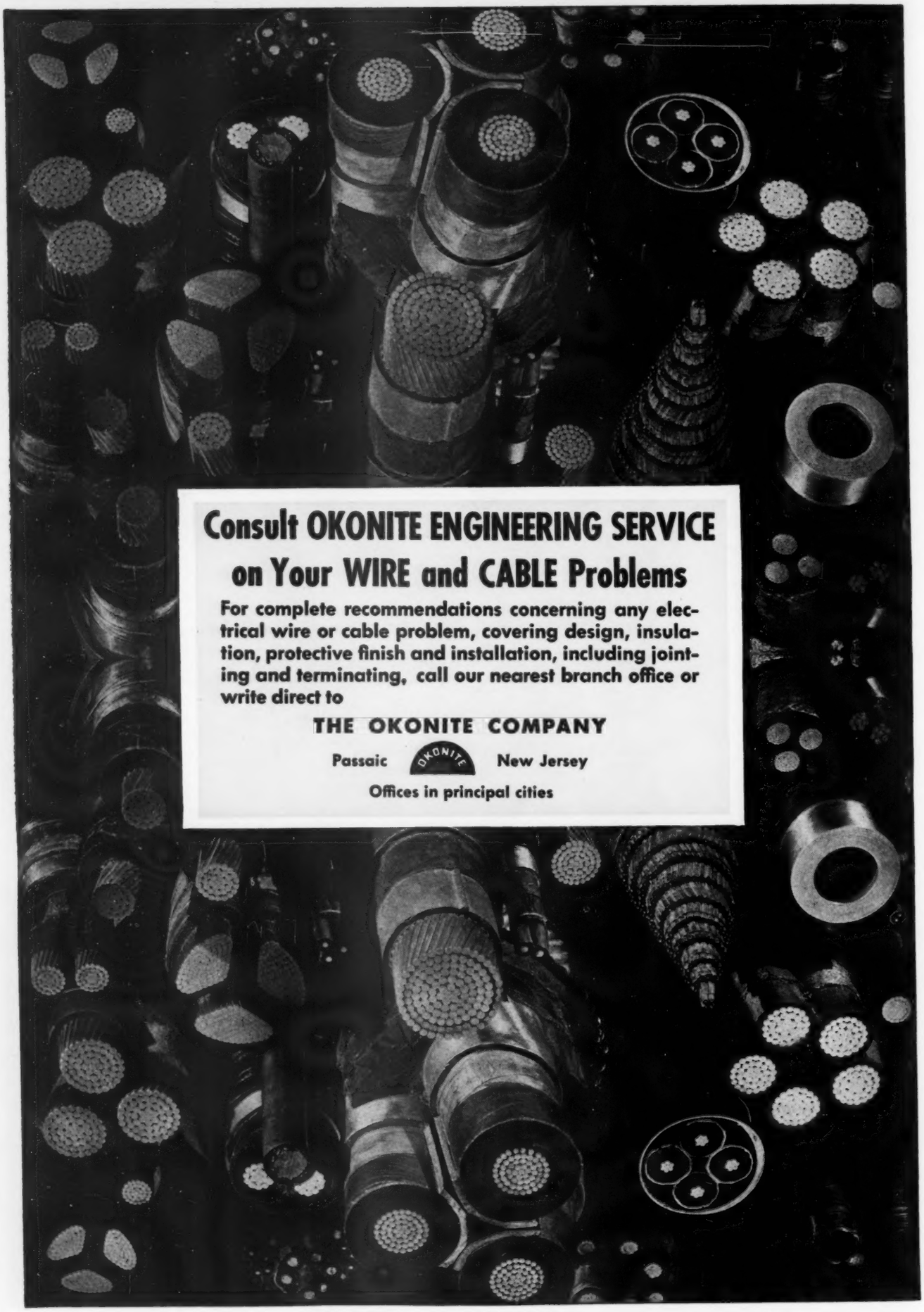
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Tomorrow's Honor

War means sacrifice. As it progresses we will have to do without this or that. Our personal pleasures and our luxuries will be sharply curtailed. These we can take because we will always feel that our own hardships can never be compared with those of the men doing the fighting for us. In that respect we will be acting as members of the public.

When we act as engineers, however, there are other emotions, other ideals, other principles which are going to offer mental resistance to sacrifices which must be made. Whole lifetimes of education and practice must give way to the urgency of war conditions. Naturally, unless we were convinced that what we had been doing was wrong, we are going to be afraid of the consequences of departures, of short cuts, of reduced factors of service safety. Nevertheless, if our engineering education and our years of practical training are worth anything it must be in not only our ability to adapt ourselves to difficult situations but to welcome the opportunity to do what the past has said was impossible or impracticable.

The war is going to call upon utility engineers for more generating and distribution capacity without adding units or lines. It is going to call upon them to extend the lifetime of equipment that has reached the retirement stage. It is going to call upon them to salvage for reuse much that formerly went to the junk man. It is going to call upon them to abandon pet ideas as to physical design.

The sixty years of electrical utility operation in this country have been one constant effort to achieve perfection in service. Reserve capacity in power plants, in substations, in lines, has been demanded as an assurance of service continuity. New equipment has replaced old frequently long before it was worn out in order to provide a better, a cheaper and a safer service. Departures from standards reflected the conviction of individual engineers; not that the standard wasn't good, but that their way was better.

And now shortages of materials and of factory production facilities are going to require of the engineer something radically different. Where a lifetime has been spent in seeing how reliable and continuous a service can be rendered, the engineer will be called on to provide a service that, while good, does not try to protect itself against every possible contingency, but reflects the facts of life—a service to the non-defense load that does not assure supply without an interruption for a decade or two, but one which will pop out now and then when unexpected and unusual strains are put upon it.

The approach to these new problems is the all-important thing. If the reluctance to change brings forth but a half-hearted attempt to do the job the result will probably not be worth the effort. If, on the other hand, the engineer approaches these new problems with the conviction that something must be done and it must be good—it will be good.

To those engineers who, though appreciative of the hazards to service that are involved, believe that something worth while can be done will come the greater satisfaction in seeing long after this war is over that what they accomplished in an emergency is in peace the accepted practice.

The sacrifice of today can become tomorrow's honor.

Minimizes Contact Possibilities of Transmission Wires

Elliptical-area analysis of possible and probable gallop of conductors indicates design clearances conducive to freedom from contact outage

A. E. DAVISON, Hydro-Electric Power Commission of Ontario*

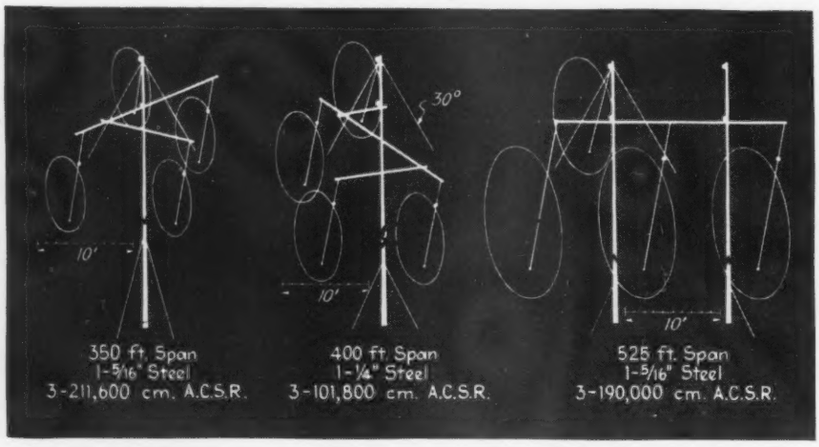


FIG. 1—Advantages of short spans on wood piles with relatively smaller whipping areas assumed for this article are evident. The dots indicate the end of each sag as used in determining the controlling dimensions for the loop. Thirty degree shielding lines are drawn from each "sky-cable" support

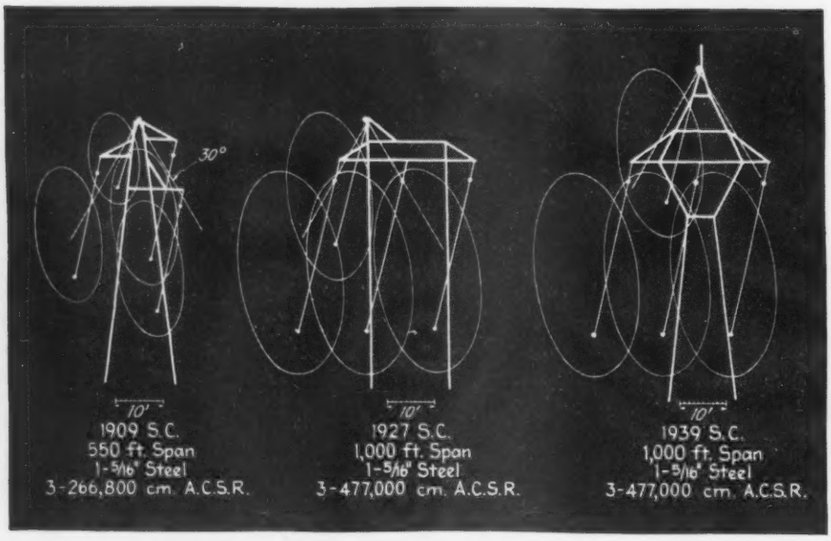


FIG. 2—All three configurations indicate, because of the amount of sag which can be estimated from the scale chart, that conductors will, if they move about, contact one another as they do in practice during certain sleet storms

REVIEW of characteristics of lines having certain conductor clearances which have operated reasonably well (except during glaze storms) over a long period of time indicates economically desirable increments in wire spacings to reduce still further the frequency of outages. Accompanying drawings, which show the application of "loops" or ellipses to several types of old and new transmission structures, may assist those who attempt to apply these loops or figures to lines which require study because of their operating characteristics.

Conductor Clearances

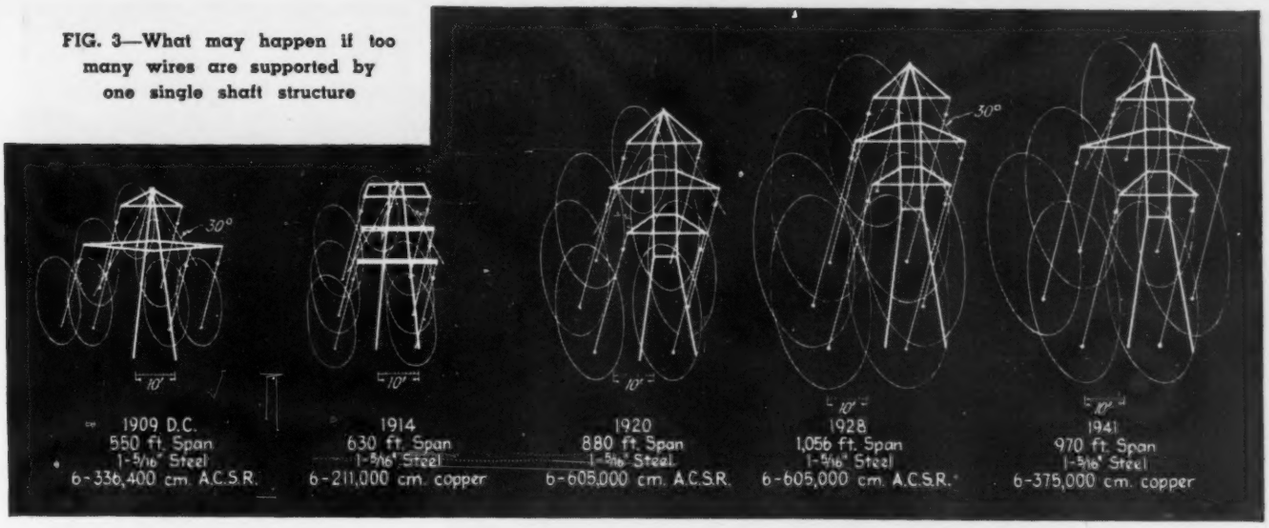
Now that lightning-proof designs seem within the realm of possibility, the most important single consideration in any effort to insure continuous service over modern, mechanically secure transmission lines is clearance of electrical conductors from one another and from electrically grounded objects at all times and during all kinds of weather. It would appear that engineers have not until recently seriously examined the clearance requirements of conductors first reported† in ELECTRICAL WORLD, January 26, 1929. In that report vertical movements in the center of the span were in excess of the total sag and horizontal movements about half that amount. Such comparisons have been made‡ and operating experience of lines having many like characteristics, but in which clearances differ, has

*Transmission engineer.

†"Dancing Cables Affect Service," W. K. Archbold, pages 199-202.

‡Powerton-Crawford 220-Kv. Line Design and Construction Features.

FIG. 3—What may happen if too many wires are supported by one single shaft structure



The charts are on a basis by which they can be fairly compared with Figs. 1 and 2, excepting that large conductors may perform during glaze storms with following winds a little differently from smaller conductors with shorter spans

been recorded. These recorded data show conclusively that greater service security results from greater conductor clearance.

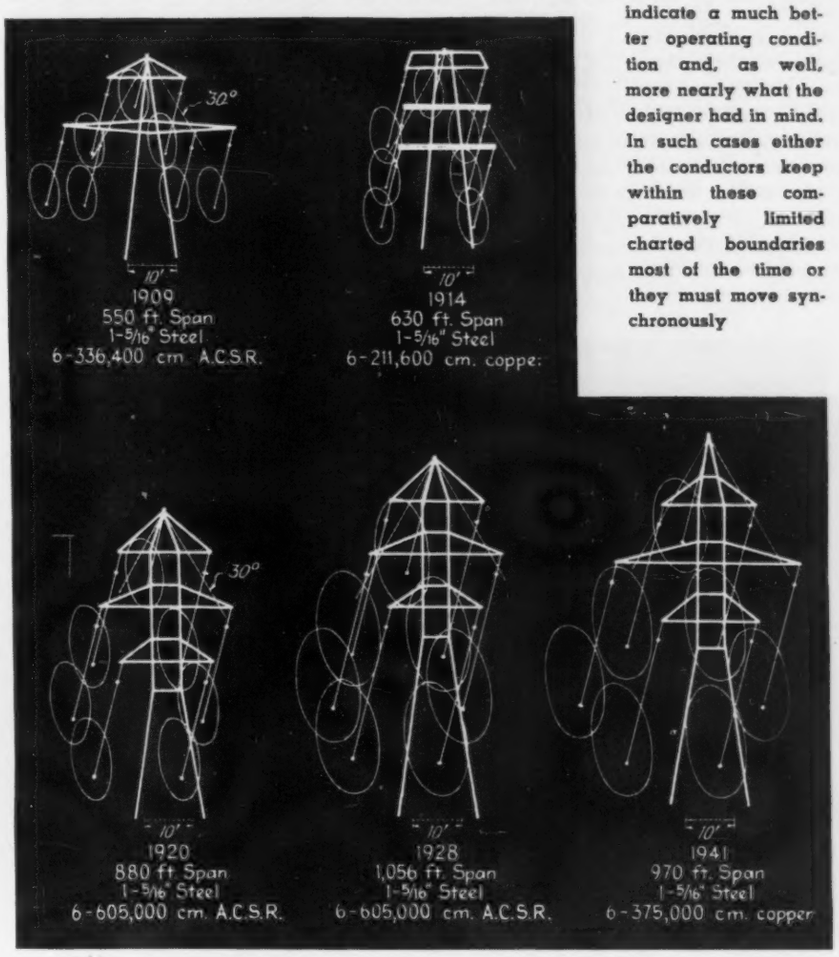
Further study has been made of the so-called "practical" loop, its dimensions and its relation to the stabilized sag at 30-mile wind and ½-in. ice. Moving pictures of some eleven cases of galloping were each examined by four engineers to arrive at the highest and the lowest average points of gallop with respect to the point of support, and the stabilized sag point and where and what the maximum horizontal motions were. All dimensions were expressed in percent of the loaded conductor sag. Eleven sets of average loop boundaries so obtained were then averaged and combined with the average of the seven authenticated cases described in the previous technical report,¶ and averaged again.

Average Loop Dimensions

Dimensions for this new average figure were greater than for the "practical" figures, but only by approximately 5 percent. These efforts to establish an average case disclosed the fact that the whole figure is moved upward with reference to the point of support by approximately 15 percent of the sag when compared with the location of the "practical" loop. This fact does not change the relation of one loop to another, since all loops are moved upward, and for that reason no change is now suggested in the so-called "practical" loops as a result of this study. These proposed clearances are not a guarantee; they simply give the designer, who is not familiar with galloping, that area which his cable occupies in most, but not all, glaze storms with following winds. With only one or two exceptions the galloping studied had one or more node points per span.

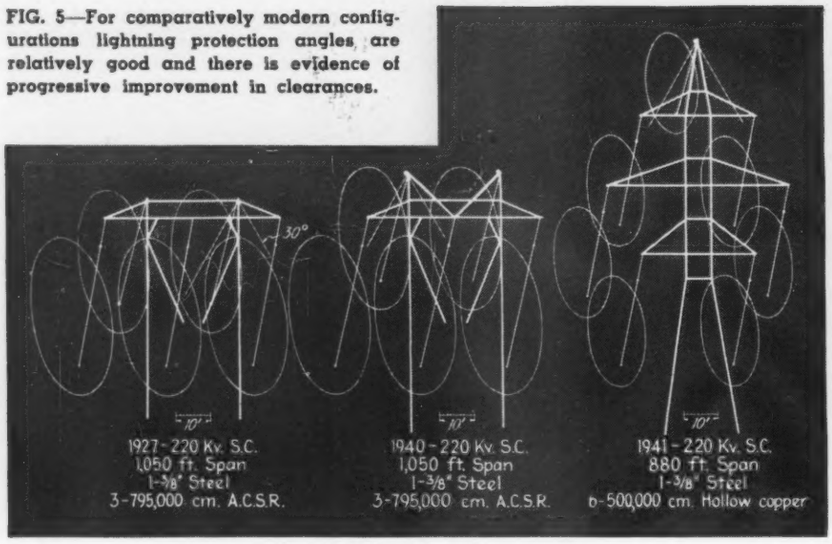
Some designers of transmission lines elect to use the presumed econo-

FIG. 4—Half loops or any smaller loop applied to lines having moderate clearances indicate a much better operating condition and, as well, more nearly what the designer had in mind. In such cases either the conductors keep within these comparatively limited charted boundaries most of the time or they must move synchronously



¶Ice-Coated Conductors, *HEPC Bulletin*, September, 1939.

FIG. 5—For comparatively modern configurations lightning protection angles are relatively good and there is evidence of progressive improvement in clearances.



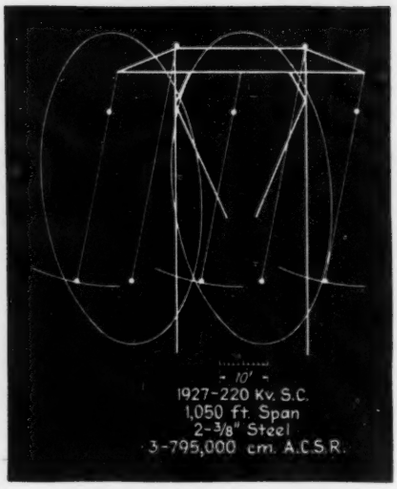


FIG. 6—Observers in the field record that glaze-loaded sky cables had stretched so that the lowest points of sag were at the same elevation as the conductors unloaded due to internal heat. These conductors are sagged normally to a point 13 ft. 6 in. below the sky cables

mies which are largely first cost and which result from the use of higher mechanical tensions and longer spans, even if it should later be established that security of service, for instance, had been depreciated somewhat. Others take the stand that lesser sags and mechanical tensions mean less need for greater clearances between phases and fewer hazards. They think the result will be longer life and greater securities, but, in most cases, somewhat greater first cost.

There is, in the following examples and comparative studies, some evidence that the development of clearances and satisfactory configurations in double-circuit lines has not been either as rapid or as effective as in single-circuit construction. This may be due to the fact that double-circuit lines are built with economies more in mind than securities, since they are less expensive per circuit-mile or per kilowatt transmitted. So far as security is concerned, however, trouble in one circuit is sometimes carried over to the neighboring circuit on the same structure. Records indicate that every third or every fourth outage in one circuit occurs either simultaneously in both circuits or the fault is communicated to the second circuit.

Wood-Supported Lines

Short spans provide areas within which a point on the conductor near the center of the span (Fig. 1) may whip about in space and still have sufficient electrical clearance to keep flashovers at a minimum. If the poles do not extend above the arm attachment so that the sky cable can be attached 5 ft. or so above the uppermost arm attachment, then clearances between sky cable and phases will be deficient.

For the single-pole supports (Fig. 1) one phase is not as well shielded as all phases appear to be on the two-pole structures; however, experience with shielding indicates that if all phases are within a 45 deg. shielding area, then extra expense in raising the sky cable is not usually warranted.

If communication circuits or other auxiliary wires must be added to either of these wood-supported higher voltage services, then clearances of necessity become very much more restricted, since poles long enough to provide safe vertical clearances are not economically available.

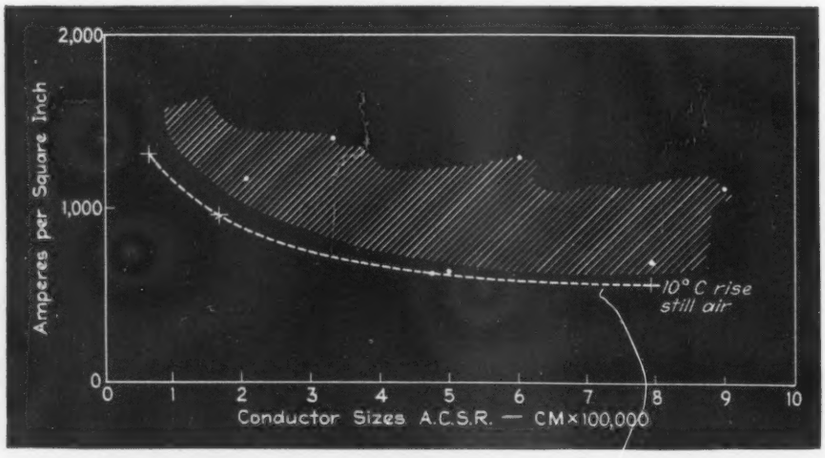


FIG. 7—Amperages in operating phases which were thereby kept clear of glaze while ice was forming on ground wires and on other cold conductors. The four cases having the lowest amperage are quite likely minimum. The lower margin of the hatched area indicates a line along which glaze rejection may be expected for many sleet storms. The parallel dotted line is a record of 10 deg. C. rise of temperature in still air for aluminum conductors (Luke)

Analysis of Typical Constructions

Single-Circuit Steel Supports, 110 Kv.—In some of the later types of single-circuit steel supports (Fig. 2) it is evident that an effort has been made to get the sky cable out of the area within which the phases are indicated as moving about. In the 1939 type the point of support of the sky cable has been moved very much higher than usual above the middle phase position.

The sag in some of the most recent designs for steel supports, being one

[*Continued on page 52*]

Portable Show Boosts Industrial Lighting

Public Service Company of Northern Illinois brings improved lighting equipment to industrial plant executives through portable lecture-demonstration stage

IN A BUNDLE that might be labeled "Defense Lighting Portable Show," Public Service Company of Northern Illinois has neatly packaged the story of modern industrial lighting and is delivering it at the doorstep of industrialists in the area around Greater Chicago.

The show, which is arranged to fold up and pack away in a station wagon, or other small truck, was designed to reach small groups of 50 or 60 industrial executives, engineers and plant superintendents with a concentrated presentation of science of seeing facts backed by demonstration of the latest industrial lighting equipment, both incandescent and fluorescent. To such groups the show brings the essential facilities for lecture demonstrations usually associated with the permanent "lighting institutes" of metropolitan centers.

As a promotional activity of this Illinois utility, the portable show is designed to capitalize on the national defense industrial lighting market by showing plant managers how they can attain the increased production vital to effective defense activity through better lighting of industrial areas.

While the theme of the presentation is tied directly to the part of better lighting in national defense industrial production, no effort is made to reach the major "defense plants" of large industrial organizations. But rather the demonstration lectures are aimed at existing industrial customers, large and small, who have been in the Chicago area for some time. Some of these may already be working on government orders, others are potential defense industries. All, however, are or should be interested in increasing production or cutting costs so they can better met financial burdens of the defense program.

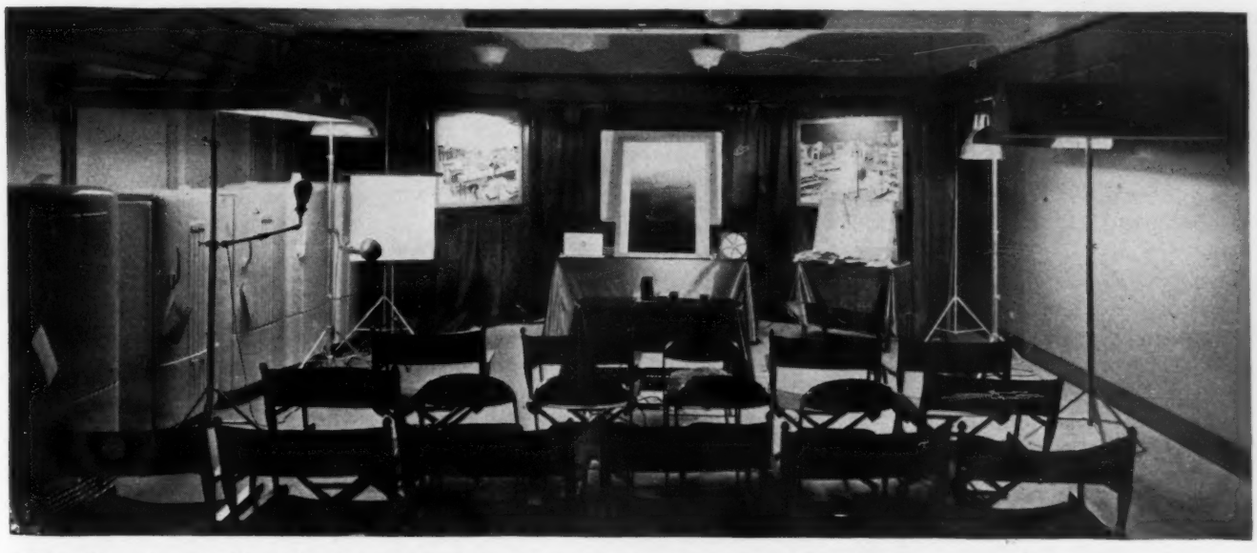
General layout of physical equipment for the demonstration is shown in the accompanying illustration. It can be roughly classified as (1) laboratory demonstration equipment to illustrate science of seeing facts; (2) illustrated charts and tables, pictures and slides for presentation of data, and (3) actual industrial lighting and protective outdoor lighting equipment of the most modern type.

The lecture materials are arranged on tables in front of an adjustable backdrop of drapes hung from collapsible frames. The demonstration fixtures are mounted on similar collapsible racks. Briefly enumerated, the equipment includes:

1. Laboratory apparatus for demonstrating the four factors of vision: (a) size, (b) contrasts, (c) brightness and (d) time.
2. Direct and reflected glare demonstration equipment.
3. Light control panel with assortment of lenses and reflectors' shapes to show how distribution of light is controlled.
4. Visibility chart and meter.
5. Assortment of industrial lighting fixtures:
   (a) Two-lamp, RLM type, 100-watt, fluorescent unit.
   (b) Two-lamp, open-end, 40-watt fluorescent unit.
   (c) Two-lamp rectified fluorescent unit.
   (d) Single-lamp troffer unit for recessed mounting.
   (e) 400-watt, high-bay mercury-vapor unit.
   (f) 300-watt incandescent silver bowl diffuser.
   (g) Floodlighting and fence lighting units for protective yard lighting.
   (h) Projector lamps.
6. Screen for projection of slides.
7. Assorted charts, pictures, slide projector and necessary rheostat and other control equipment.

The backdrop and laboratory type

[*Continued on page* 107]

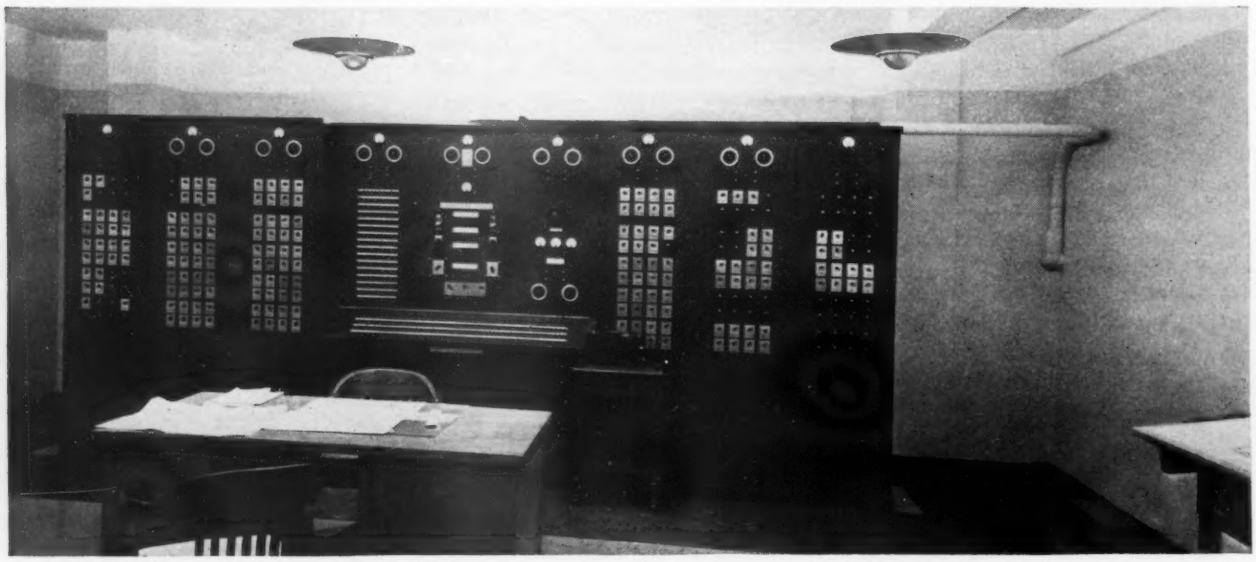


EXAMPLES of the latest types of industrial lighting equipment, both fluorescent and incandescent, particularly for defense purposes, are displayed to industrial groups in the Chicago area

Novel Features Mark A.C. Calculating Board

Fixed-value line impedance units, permanently connected network, 60-cycle supply source, elimination of cords and jacks in permanent network and of amplifiers distinguish calculating board designed specifically for single utility operating system

E. B. PHILLIPS, Oklahoma A. & M. College; L. C. GRIGSBY, Public Service Co. of Oklahoma, Tulsa



A.C. CALCULATING BOARD is housed in three-section all-metal cabinet 16.5 ft. long, 7 ft. high and 2 ft. deep. Six cells contain 54 drawers housing reactors, capacitors and transformers. Front-mounted rotary tap switches control the variable elements such as loads, transformer taps, spare line impedances and generator internal impedances. Phase-shifter units simulate seven generating stations. Central section contains master metering equipment, power control and 240 installed lever type telephone keys which either open the circuit in which installed or switch it into metering circuit

BY DESIGNING an a.c. calculating board for its own and portions of interconnected systems, and consequently being able to use fixed-value line impedances and permanently connected apparatus, Public Service Company of Oklahoma was able to simplify the circuits and to reduce the size and cost of a system analyzer.

When using a power conversion scale of 200,000 to 1 the board has a total present generating capacity of 448,000 kva. and a total present loading capacity of 425,000 kva. Excess, unattached equipment provides for about a 10 percent margin above present requirements. Cabinet space is further available for the addition of about 10 percent more equipment plus two more generating stations. Additional cells may be added at either end.

Positive and negative sequence network contains 63 fixed-value reactors and resistors that represent line impedances, fixed-value capacitors connected to the buses that simulate line capacitances, 24 additional adjustable-value reactors and resistors that may be readily connected between any buses for use in investigating new lines operations, and fourteen miniature transformers of high efficiency, low impedance and low excitation, each containing the same number of taps as the unit it simulates in the system. The internal reactance of each generating station is represented by a multi-tap reactor, the amount used being determined by the number of generating units considered to be in use and by whether the positive or negative sequence network is being used.

This network also contains 26 permanently connected and four extra load units, which can readily be connected to any point in the network by jumpers on the main frame. Ten of these units operate at a fixed power factor of 80 percent, adjustable in eleven steps from 200 to 2,000 kw., system equivalent power. Eighteen load units have a range of 100 to

11,000 kw. in 110 steps and a reactive load range of 333 to 14,000 rkva. in 42 steps. Two load units have a range of 200 to 22,000 kw. in 110 steps and a reactive load range of 833 to 35,000 rkva. in 42 steps.

The separate zero-sequence network consists of 61 fixed-value resistors, representing the zero sequence component impedance of lines, generators and transformers.

Each Station Represented

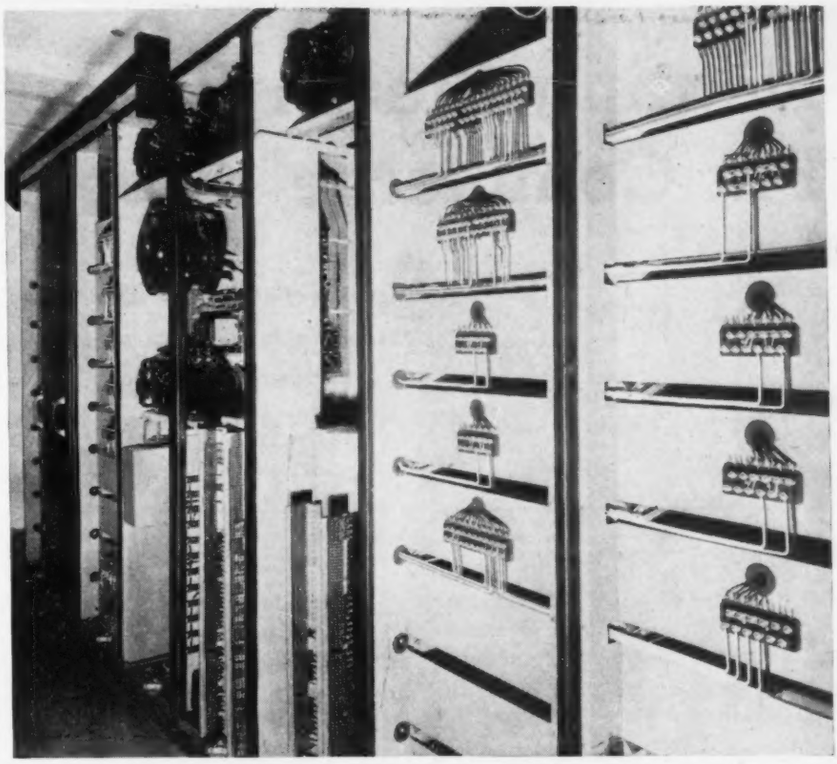
Each generating station is represented by a pair of phase-shifter units, the single-phase secondaries of which are connected in series, while the primaries of each receive power from a three-phase source. Power is supplied to the phase shifters by a three-phase, 115-volt, 60-cycle, 5-kva. sine-wave generator driven by a 10-hp. synchronous motor. Taps are brought out to a voltage-selection switch by which a choice of three basic voltages, 100, 50 and 10 percent, may be made. Intermediate values are secured by field rheostat control.

Faults can be placed on the positive and negative sequence network at 88 ultimate places, and at a like number of ultimate places on the zero network by turning the proper one of sixteen 11-point rotary tap switches to the setting that corresponds to the point in the network. A lockout relay makes it impossible to apply a fault until a reduced voltage is used on the network.

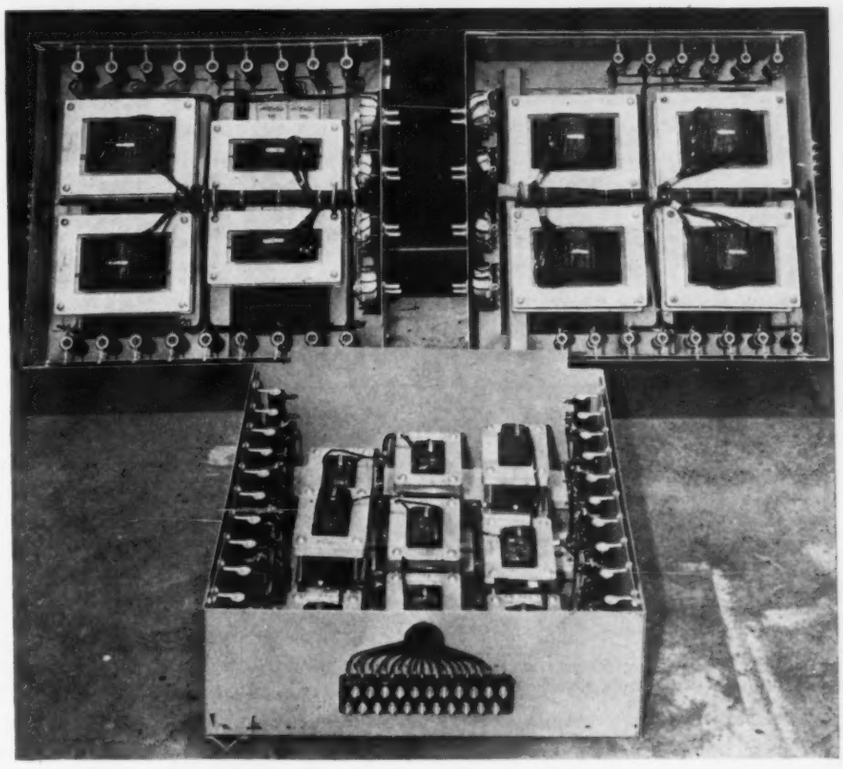
Conversion scales used on this particular application are, as applied to line volts, 1,000, 500, 250 and 100. The "500" scale applies to the 66-kv. base, the base on which this analyzer is set up. On this 66-kv. base the other reduction scales are: Watts and reactive volt-amperes, 200,000 to 1; amperes, 231 to 1; ohms, 0.8 to 1.

The ranges of the master metering circuit, stated in system values on the 66-kv. base, are: Vector volts, 300 to 75,000; vector amperes, 2.3 to 693; kw. and reactive kva., 20 to 64,000.

Some of the studies and investigations that have been made on this analyzer consist of short-circuit studies involving all fault types, voltage regulation and power flow studies, static and transient stability studies and investigations to determine the most economical method of supplying power to new load centers that require additional feeders or extensions to the present system network.



REAR OF BOARD presents neat and compact appearance through use of dust-tight doors, similar to one at far left, normally inclosing bays. Main terminal frames are visible in lower part of center section. Several phase shifters and voltage regulators used for representing generating stations can be seen at top of center section.



DRAWER ASSEMBLIES housing analyzer components slide from back of board. Two rear drawers indicate interconnections between reactors, resistors and rotary tap switches. Spindles of these switches protrude through carefully aligned holes in front panels. Thirty drawers of the type in the rear hold transformers, loads, regulators and the variable type units of reactors and resistors. Twenty-four drawers of the type at the front contain the fixed value units of reactors and resistors.

Heating Steam Requirements Fix Commerce Street Design

Combination of electric generation and central heating facilities determines design pattern for high-pressure turbine installation — Condensing section of automatic extraction unit makes fullest use of available steam during periods of low heating steam demand — Costs of five considered plans

MORE than any other single factor, opportunities for improved system heat consumption from a combination of electric generating and central heating facilities influenced the location and arrangement of generating capacity recently put into service by the Wisconsin Electric Power Company at its Commerce Street station, Milwaukee.

Largest of its kind, the 35,000-kw. Allis-Chalmers tandem-compound automatic extraction condensing turbine selected uses steam at a throttle pressure of 1,200 lb. per sq.in. and 900 deg. F. temperature. Steam to central heating mains is extracted at 160 and 35 lb. pressure. Unlike the company's recent installation at the East Wells Street station, this addition uses a low-pressure element exhausting to a condenser at 28½ in. vacuum which can be called into service at any time. To make fullest use of the low-pressure section, the 375,000-lb.-per-hour boiler—that removes from service eight over-age existing boilers—is slightly larger than is required for heating alone.

Loading of the generator is governed to a large extent by electrical requirements of the system. However, during light electrical load periods generation by the new machine will be determined principally by steam-heating requirements. Conversely, at low heating demands and high electrical peaks the extra capacity from the low-pressure element will be called upon. Diversity between heating and electric peaks permits advantage of most of the extra electrical capacity to be taken at all times.

Further, the possibility of carrying running reserve for 24 hours a day instead of fourteen hours made a condensing installation attractive, since the turbine, floating on the heating load during lighter electric load periods, can instantly increase its output to the maximum, enhancing service reliability.

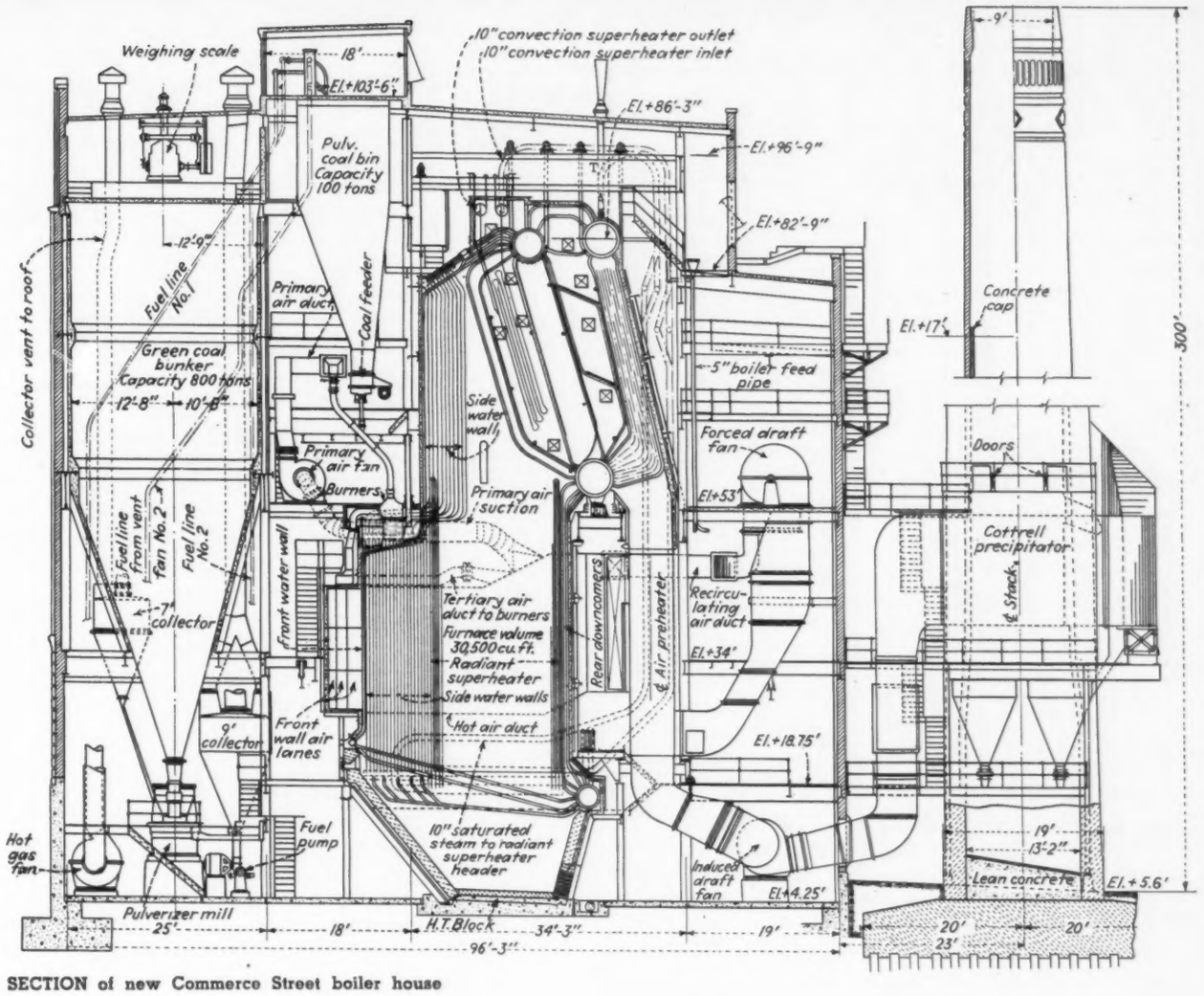
More Capacity Needed

While generation by condensing at Commerce Street is not as economical as at Port Washington, and perhaps not as economical as the 1,200-lb. section at Lakeside, by-product generation from heating steam is definitely more economical than generation at either of these two plants, being of the order of 4,500 B.t.u. per kilowatt-hour.

When the study leading to the Commerce Street installation was made demand on the system was in-

Operating Costs for Various Plans

		Port Washington		Commerce Street		
		80,000 Kw.	35,000 Kw.	15,000 Kw.	35,000 Kw. 1 Blr.	35,000 Kw. 2 Blr.
	Cost of coal					
1.	Paid to coal company, dollars per ton	3.80	3.80	3.95	3.95	3.95
2.	Dock charge, dollars per ton	0.21	0.21	0.50	0.50	0.50
3.	Trucking, dollars per ton	....	....	0.24	0.24	0.24
4.	Storage yard oper. cost, dollars per ton	0.02	0.02	0.07	0.07	0.07
5.	Total cost of coal, dollars per ton	4.03	4.03	4.76	4.76	4.76
6.	Annual generation (by-product), net kw.-hr. (thous.)	.....	.....	30,000	30,000	30,000
	Annual generation (condensing), net kw.-hr. (thous.)	264,000	144,000	.....	114,000	114,000
	Total generation, net kw.-hr. (thous.)	264,000	144,000	30,000	144,000	144,000
7.	Annual heat consumption (by-product), B.t.u. per net kw.-hr.	.....	.....	4,500	4,500	4,500
	Annual heat consumption (condensing), B.t.u. per net kw.-hr.	11,500	12,000	.....	13,000	12,800
	Total annual heat consumption, B.t.u. per net kw.-hr.	11,500	12,000	4,500	11,230	11,071
8.	Average heat content of coal, B.t.u. per lb.	12,800	12,800	12,800	12,800	12,800
9.	Coal consumed, tons per year	118,600	67,500	5,270	63,170	62,270
10.	Total annual fuel cost, dollars per year	477,960	272,020	25,090	300,690	296,400
11.	Unit fuel cost, cents per net kw.-hr.	0.181	0.189	0.084	0.209	0.206
12.	Other operating and maintenance costs, dollars per year	129,240	87,980	10,910	44,910	54,900
13.	Unit other operating and maintenance costs, cents per net kw.-hr.	0.049	0.061	0.036	0.031	0.038
14.	Total production costs, dollars per year	607,200	360,000	36,000	345,600	351,300
15.	Unit production cost, cents per net kw.-hr.	0.230	0.250	0.120	0.240	0.244



SECTION of new Commerce Street boiler house

creasing at the estimated rate of 30,000 kw. per year. Of the possible locations for installation of the needed electric capacity, most logical appeared to be the Port Washington or Commerce Street station.

At Port Washington a duplicate of the present unit was considered, since engineering and equipment could be largely duplicated. An 80,000-kw. unit would continue original design and fit into the layout better than any other. However, a 35,000-kw. size was also considered.

Commerce Street was considered because (1) electric facilities could be combined with heating facilities to improve system heat consumption, (2) new boiler capacity was needed to remove from continuous service eight of 24 over-age boilers, (3) new boilers would increase boiler efficiency and cut maintenance costs, since heating steam could be supplied by them, (4) electrically, Commerce Street is in the center of the Milwaukee distribution system, (5) some 60-cycle standby was maintained at Commerce Street, and by combining actual generation with standby service a saving in operating costs would result.

Existing 60-cycle standby capacity at Commerce Street amounted to 30,000 kw. and used sixteen available boilers in No. 2 and No. 3 boiler rooms. It seemed logical to continue these boilers for 60-cycle standby services with existing turbines. Thus the eight over-age boilers in No. 1 house would be available for supplying heating steam. Their capacity would be about sufficient to supply peak heating demand of 282,000 lb. per hour on the Commerce Street station, which was then limited by the 293,000-lb.-per-hour capacity of mains out of the stations.

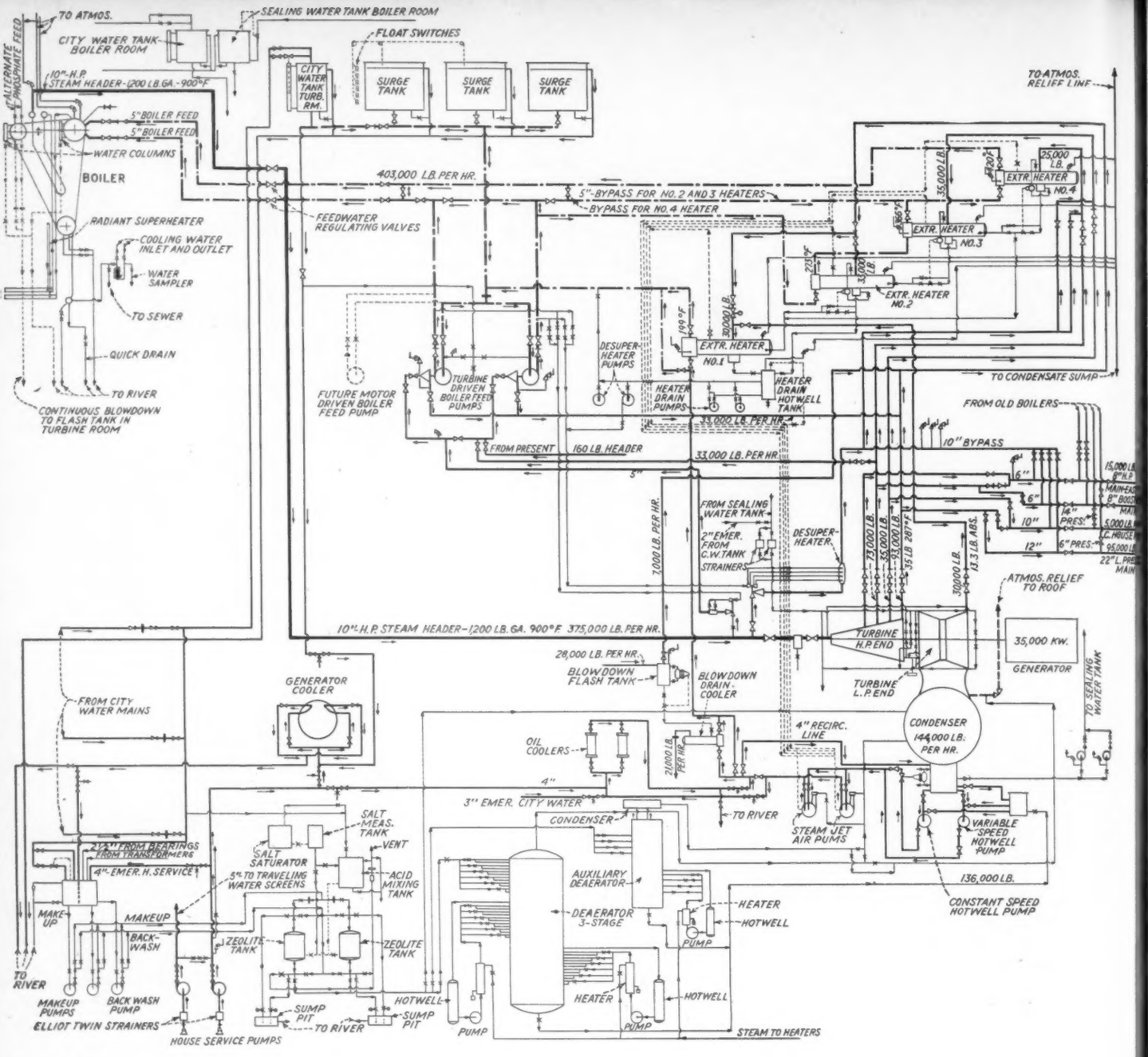
The study at Commerce Street then resolved itself into a comparison of various plans for providing new boiler capacity for steam heating either through replacing the old boilers or by adding a new boiler in an available lot north of the plant. Installation of new boiler capacity offered an opportunity for providing needed electrical generating capacity through using high-pressure steam and passing it through a turbine to take out energy while reducing its pressure to that suitable for heating mains.

Discussions of Plans

Comparative cost of several schemes considered for adding capacity at Port Washington and Commerce Street stations are summarized in accompanying tables. *All costs given are relative only.*

Five alternate plans were considered:

Scheme (A)—An 80,000-kw. unit duplicating the unit already in operation. Its performance is well known. An average annual heat consumption of 11,200 B.t.u. per kilowatt-hour was



FULL LOAD FLOW DIAGRAM for 35,000-kw. addition to Commerce Street plant

used for the second section due to low load factor. A unit investment cost of $85 per kilowatt was estimated.

Scheme (B)—A 35,000-kw. unit at Port Washington. While a unit of this size requires smaller total investment, the unit investment is relatively high. An extension to the outdoor substation equal in length to that for the 80,000-kw. unit would be needed to provide sufficient clearance for a second transmission line out of the plant. Unit investment of $108.50 was estimated and a heat consumption of 12,000 B.t.u. per kilowatt-hour.

Scheme (C)—A 15,000-kw. non-condensing unit at Commerce Street. This plan proposed one high-pressure boiler with continuous capacity of 300,000 lb. per hour and 325,000 lb. per hour on extreme peak to remove from regular service the eight over-age boilers in No. 1 boiler house. This boiler would supply peak-heating steam demands on Commerce Street. This arrangement would provide as a by-product a maximum of 15,000 kw. of needed electric capacity using steam at 1,200 lb., 880 deg., and exhausting at 160 lb. and 35 lb. to heating mains. Total cost would be about $2,697,600. Because of the low load factor of the heating load (about 29 percent) the entire 15,000 kw. would be available only occasionally, since in the study base steam load was assumed taken by East Wells Street station. However, extra electric capacity could be made available at times other than peak-heating loads by adding a low-pressure element and condenser to the by-product turbine and thus increasing the total new capacity to 35,000 kw. This plan is considered below.

Scheme (D)—A 35,000-kw. condensing-extraction unit at Commerce Street with one boiler. One high-pressure boiler with a maximum rating of 375,000 lb. per hour was suggested to remove from regular service the eight over-age boilers. The condensing extraction turbine was to take

steam at 1,200 lb. pressure and 900 deg. temperature and supply heating steam at 160 lb. and 35 lb. pressure by extraction. With the low-pressure element and condenser added to the by-product turbine under this scheme 20,000 kw. of extra electric capacity would be made available at times other than peak-heating loads. This extra capacity would be available when heating demand was below maximum, and since diversity existed between heating and electric peaks advantage of most of the extra capacity could be taken at all times.

Scheme (E)—Similar to the previous one, this plan called for two boilers instead of one, each to have a steaming capacity of 187,000 lb. per hour. It offered greater flexibility in meeting heating load variations and providing standby boiler capacity.

Plan Selected

Summary tables indicate lowest unit cost for the 35,000-kw. Commerce Street single-boiler condensing-extraction installation. It is about 0.061 cent per kilowatt-hour lower than the 80,000-kw. installation at Port Washington, which if applied to an expected Commerce Street generation of 144,000,000 kw.-hr. results in an annual saving of $87,840. No credit, however, is given to Port Washington for the extra capacity above 35,000 kw.

Although the calculated annual saving of $87,840 for the Commerce Street 35,000-kw. single-boiler, condensing-extraction plan may be subject to change with a change of assumptions, even to the point of producing no savings over the 80,000-kw. unit at Port Washington, it was felt that such an installation was logical, could always be used and, hence, would never produce a loss; on the other hand, it would improve costs where improvement was needed.

The two-boiler plan at Commerce Street, despite better light load boiler efficiency, had higher over-all production costs and investment cost than the one-boiler scheme. The 35,000-kw. unit at Port Washington was handicapped by cost of the essential second higher capacity transmission line.

While the non-condensing unit would save as much as the extraction unit in by-product generation, the investment was not justified because of the low annual load factor (29 percent) imposed by the heating system load.

Expected Operation

Without doubt the method adopted for adding generating capacity at Commerce Street plant will require careful attention to the economics of load distribution, both steam and electric. This is not an insurmountable obstacle. With careful dispatching, the actual savings conservatively estimated should be improved on.

About 735,000,000 lb. of steam per hour will be required by the heating system out of Commerce Street. Most of this steam first passes through the turbine. Peak-heating steam demand is about 282,000 lb. per hour, corresponding to 29.7 percent load factor. Average demand for the 6,600 hours of the heating season is about 110,000 lb. per hour. Load duration curves show that the heating demand on this station is 15,000 lb. per hour (summer for 2,500 hours and between 15,000 and 75,000 lb. per hour for 1,500 hours). During those periods of light steam demand the turbine will operate largely condensing, with an estimated annual heat consumption of about 13,000 B.t.u. per kilowatt-hour. Total annual heat consumption is expected to be about 11,230 B.t.u. per kilowatt-hour for the installation, considerably improving the over-all station heat rate.

Steam Flow Diagram

Shown schematically is the steam flow diagram for the 35,000-kw. condensing extraction turbine. Steam will normally be extracted at 35 lb. pressure to feed the 22-in. low-pressure main and the 14-in. Court House main, with a small amount of steam bled off at 160 lb. to supply the 8-in. high-pressure main in Fourth Street. With low-pressure mains loaded, the 8-in. booster main in Fourth Street will be loaded with steam at 160 lb. When demand for heating steam is low and electrical capacity is needed steam can be run to the condenser. The flow diagram shows the condition in which the generator is carrying the full 35,000 kw. and 115,000 lb. of steam per hour is being sup-

[*Continued on page* 103]

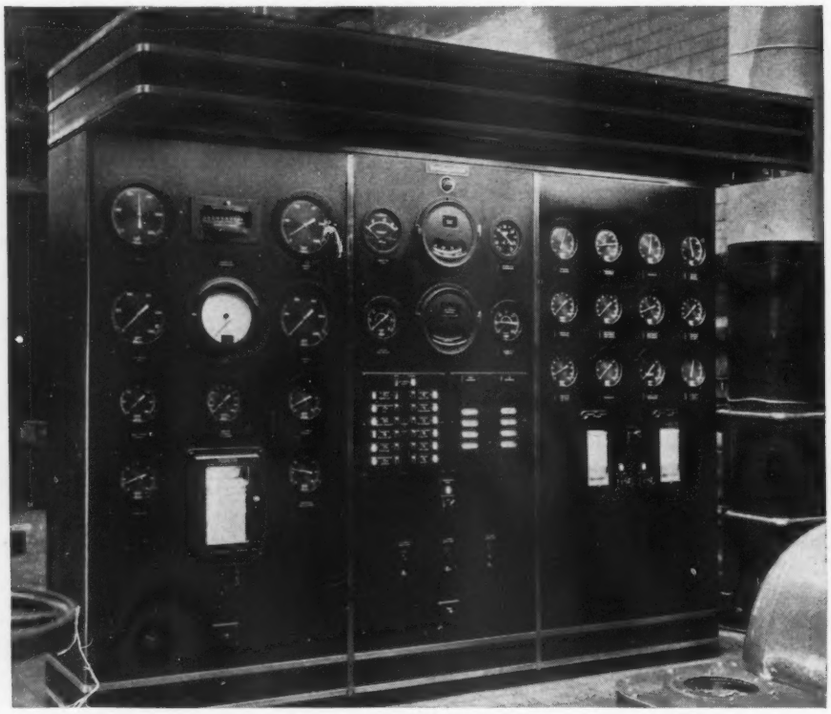
Comparison of Costs for Various Installations

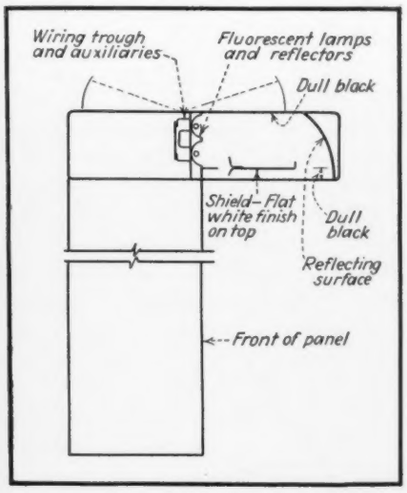
		Port Washington		Commerce Street		
	Investments			Non-Cond.	1 Boiler Cond. Extr.	2 Boilers Cond. Extr.
1.	Proposed installed capacity (kw.)	80,000	35,000	15,000	35,000	35,000
2.	Unit investment in power plant	$85	$108.50	$179.80	$110.50	$116.50
3.	Total investment in power plant	6,800,000	3,797,000	2,697,600	3,863,100	4,077,500
4.	Total investment in transmission lines	379,000	379,000	.....	.....	.....
5.	Total investment required	7,179,000	4,176,000	2,697,600	3,863,100	4,077,500
6.	Investment credit for heating capacity	.....	.....	920,000	920,000	920,000
7.	Net investment required	7,179,000	4,176,000	1,777,600	2,943,100	3,157,500
8.	Annual F. C. at 10 percent	717,900	417,600	177,760	294,310	315,750
	Operating Costs					
9.	Annual generation (kw.-hr.)	264,000,000	144,000,000	30,000,000	144,000,000	144,000,000
10.	Unit production costs (cents)	0.23	0.25	0.12	0.24	0.244
11.	Total annual production costs	$607,200	$360,000	$36,000	$345,600	$351,300
12.	Operating credit for heating steam	.....	.....	32,000	30,400	30,400
13.	Electric losses	24,300	13,300	.....	.....	.....
14.	Credit for extra generation	71,400	.....	.....	.....	.....
15.	Net operating costs, annual	$560,100	$373,300	$4,000	$315,200	$320,900
	Combined F. C. and Operating Costs					
16.	Total F.C. and operating costs	$1,278,000	$790,900	$181,760	$609,510	$636,650
17.	Unit F.C. and operating costs	0.484	0.549	0.606	0.423	0.442

Fluorescent Lighting of Gauge Panels

Fluorescent lamps provide diffused and uniform illumination of low intensity for turbine room gauge panels — Light hoods developed, with false front reflector panels where space limitations preclude hoods

H. D. GREEN and W. C. WOODMAN, Consolidated Edison Company of New York, Inc.





LIGHTING HOOD and lighting scheme on gauge panel for Unit No. 6 at Waterside Station No. 2, as built by the Westinghouse Electric & Manufacturing Company. Fluorescent lamps, backed up by parabolic polished reflectors, provide diffuse, long-lived lighting source

HOW MANY badly illuminated panels one can find—gauge panels that lack illumination, instrument panels that show a confusing light reflection in the instrument glasses, or control panels where the operator must stand in his own light to read the instruments! When the state of illumination is so bad that an operator is forced to employ his pocket flashlight, the time has arrived for remedial measures.

Two departures from common practice in panel illumination have been developed as a result of ineffective lighting in the Consolidated Edison Company's Waterside No. 2 generating station. In this station the turbine room has some unique features which make panelboard illumination unusually difficult. Many turbine rooms are so constructed that gauge panels in the walls receive sufficient light from the general illumination in the room due to horizontal reflections from the white walls. In such cases there is no problem in obtaining adequate lighting on a panel board without a local source of illumination. Since the light comes from high above the panel, and is a diffused light coming from all angles, there are no reflections, nor can the operator stand in his own light.

However, in the Waterside station the turbine room is long and narrow, with dark walls. At the operator's eye level all general illumination is principally vertical. Furthermore, layout conditions required that the panelboards be set in cabinets on the operating floor rather than in the walls of the room.

Lighting Study Made

A study of this situation brought out the following facts:

1. No unusual intensity of illumination is required for a panelboard—5 to 8 foot-candles intensity measured horizontally at the instrument dials

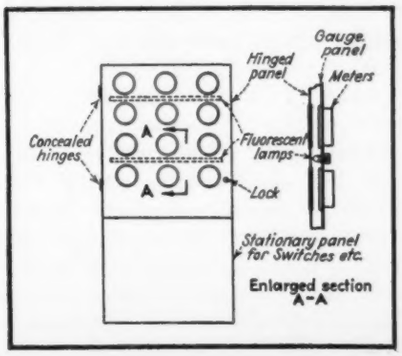
is most effective. Too high an intensity seems to run together the divisions on the dials, especially where the operator must watch the panel continuously, but the light must be diffused and as uniform as possible. Glare resulting from specular reflection is disturbing and obscures the reading of instruments.

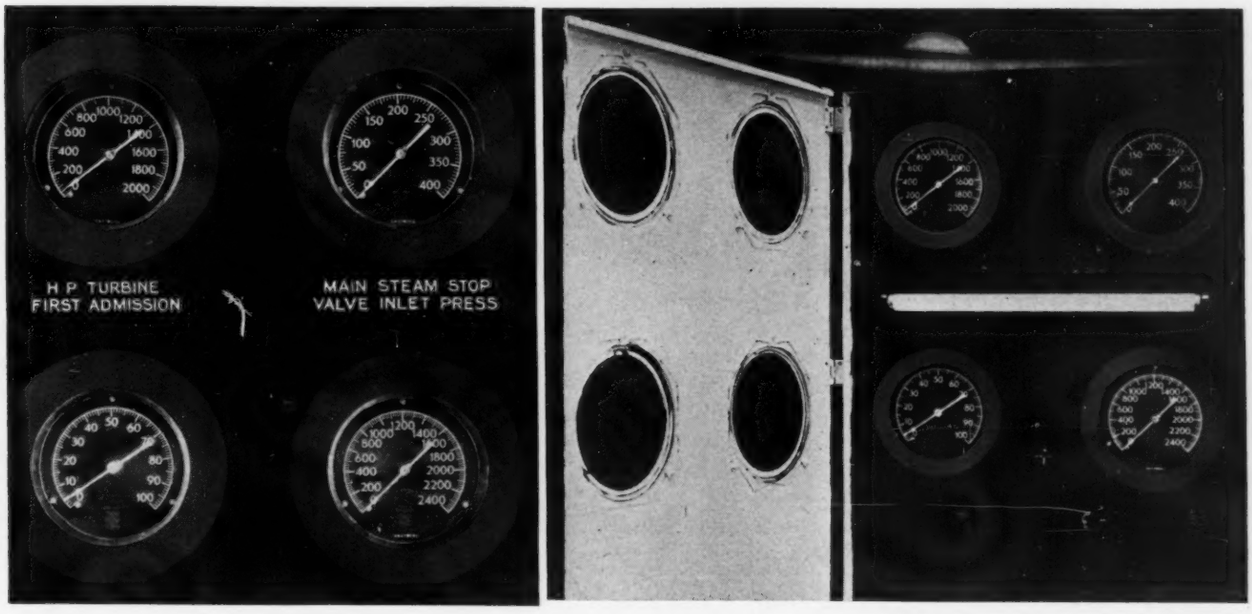
Although, as pointed out above, a fairly high level of general illumination was available at Waterside, the horizontal component was found to be of the order of ½ foot-candle, an intensity too weak for satisfactory gauge panel lighting.

2. Individual instrument illumination is not a universally satisfactory solution. While it can readily be installed in some large recording instruments, most indicating instruments are built so as to make this installation difficult. In addition, on a panel there are too many different types of indicating instruments made by too many different manufacturers to make it practicable to bring all these into line for one common type of individual gauge illumination. It was found expensive for the Consolidated Edison Company to attempt this after the receipt of the instruments, since the cost of illuminating an instrument often exceeds the value of the instrument itself, which additional cost is only wasted should it become necessary to replace a defective instrument. Furthermore, individual gauge illumination does not solve the problem of furnishing a proper lighting for nameplates or instruction plaques mounted on the panel.

3. Illuminating panelboards from spotlights mounted on the opposite wall is not a satisfactory solution. The operator is forced to stand in his own light and it is disturbing whenever one looks in the direction of the spotlight.

4. The installation of commercially available lights and reflectors above the gauge panel gave unsatisfactory results, because of the bright reflection of the light source or "hot spots" in the uppermost row of instrument glasses, together with a lack of illumination on the lowest portions. Largely because of the objections under (2) above, a special lighting hood was designed which would overcome the faults of commercially available reflectors. This lighting hood has the advantage that it can be applied to existing panelboards requiring local illumination, where the location and conditions do not make an overhung hood objectionable.





FALSE FRONT PANEL and lighting scheme for gauge panels. Illustrations show a model on which experiments were made prior to starting construction on the panel now under way

Lighting Hood Principles

This hood was designed on the following principles:

1. The illumination must be generated in a source of reasonably high intensity, and yet must be projected uniformly and diffusely over the panel front.

2. The source of illumination must not be seen by the operator in reflections from the glass fronts of the instruments, and it also must be screened from his direct view.

3. The lighting hood must distort the appearance of the gauge panel as little as possible.

4. The light source must have a long life to avoid frequent replacement, and the reflectors must be arranged so that they are vertical or inverted to avoid catching dust. A diffuse yet efficient and long-lived source of illumination called for the use of fluorescent tubes. These were backed up by parabolic polished reflectors, arranged to throw the light horizontally forward toward a special curved reflector in the front of the hood. This latter reflector was laid out with a curvature designed to

throw the emerging rays of light to the lower part of the panel where the distance of travel is longer.

The extreme upper section of the panel is illuminated by a small louvered reflector in order to prevent reflections at eye level. All reflectors are mounted vertically or inclined downward to avoid the collection of dust and are so located that their image does not appear in the glass fronts of the gauges.

At the request of the Consolidated Edison Company, both the General Electric Company and the Westinghouse Electric & Manufacturing Company constructed these lighting panels for gauge panels which they were furnishing for two 65,000-kw. high-pressure turbine generators currently being installed in the Waterside station.

False Front Reflector Panel

A second type of panel illumination will be used for a third turbine generator unit at another generating station. In some instances, as in this one, space limitations may make a hood objectionable. As a result the false front lighting panel was designed. This method of illumination is similar in principle to an automobile instrument panel and is in the process of manufacture.

One fluorescent tube which produces a distributed source of light is mounted between two rows of gauges on a common panel, in front of which is a hinged panel with glass windows opposite each instrument. The inside of the front panel is finished flat white and is used to reflect the light upon the instrument dials. The light is reflected from all directions, eliminating the shadows that might be caused by the pointers or rims on the gauges if a concentrated light source were used. The fluorescent tube is best suited for this totally inclosed construction because of its low heat radiation. Size and wattage of the tube used are determined by the dimensions of the gauge panelboard.

The false front panel has these advantages:

1. There will be no falling off in illumination on the portions of the panel most remote from a lighting hood.

2. Hot spot reflections become impossible.

3. With the source of light mounted behind the front glass the mirror-like effect observed when standing in front of an instrument is greatly reduced.

Eight Foot-Candles

The illumination intensity depends upon the distance between the gauge dial and the front reflector panel. An illumination intensity of 8 foot-candles is obtained at the face of the dial with a distance of 1¼ inches, using a 15-watt tube to illuminate four gauges. It is not necessary to remove the instrument glasses, thereby retaining the additional protection that these afford against dust. Nameplates are illuminated simply by cutting a slot in the false front under each instrument and placing over it a piece of translucent material bearing the name of the instrument. Lamicoid proves a very satisfactory material for this. Recorders which do not lend themselves to being covered with a false front can be given a local light and segregated in a special section of the panelboard not covered by this hinged front.

Minimizes Contact Possibilities of Transmission Wires

[*Continued from page 42*]

and a half to two times as great as that found in almost any wood construction, creates some difficulty; however, it is hoped by some engineers that the inherently heavier cables will not move around when glaze-coated as much as is indicated by the chart.

Double-Circuit Construction, Steel Supports, 110 Kv.—The double-circuit construction (Fig. 3) is not relatively desirable when comparing loops within which the phases at midspan may travel.

Half-Loops — Diagrams of half-loops (halved range) have been introduced so that engineers who are of the opinion that smaller loops are adequate for such studies may more readily make comparisons and draw their own conclusions. (Fig. 4.)

220-Kv. Steel Supports—It is evident that relatively good performance should be secured from the 1941 double-circuit tower shown in Fig. 5. The loops are on the same basis as those for the 110-kv. double-circuit towers of Fig. 3.

For the 1940 single-circuit 220-kv. lines the sky cable has been moved upward 8 ft. out of the area occupied by the phases, as it has been found from experience with lightning and glaze, 1927 to 1941, that such a change is desirable. These changes are minor, since the older circuits have been operating at an outage rate of 1.15 per 100 miles per year, practically all due to lightning, and because the revised height of sky cable is the maximum that can be used safely on structures which are already available.

Preventing of Glaze Formation

Sky cables, normally some 13 ft. above the power cables, have been found at some glaze-forming temperatures so loaded that their sag has been increased by 13 ft. or more, while the conductors underneath continued to operate with little or no glaze load. Fig. 6 illustrates what would happen if there were, under such a condition, a following wind which would move the loaded sky cables about, and at the same time cause the glaze-free conductors to swing in arc due to gusty winds.

J. E. Clem‖ established from the then available data and experiments that glaze can be melted off conductors. Using his methods, Fig. 7 is submitted; however, all the points on the curve have been plotted from information gained from actual field cases in which formation of glaze was either prevented or greatly retarded, but not necessarily actually melted off the cables. Most of the cases occurred when air temperatures were not far removed from 32 deg. F., and when the air was relatively quiet. Currents recorded are therefore minimum.

The lower boundary of the hatched area on this chart connects up these minimum electrical currents. It is not intended that this hatched area covers glaze melting at low air temperatures or that glaze rejection at the recorded electrical loads can be depended upon. Rejection of glaze, however, did occur.

‖"Currents Required to Remove Conductor Sleet," J. E. Clem, "Electrical World," December 6, 1940, page 1053.

Power Design in Defense Plants I—High-Voltage Supply

First of a series of articles discussing vital phases of electrical system design for new industrial plants engaged in defense production. Part I — Five high-voltage power supply and switching schemes typical of defense plant practice

HERMAN WINTE, Albert Kahn Associated Architects & Engineers, Inc., Detroit, Mich.*

ELECTRICAL SYSTEMS of national defense industrial plants face a two-fold assignment. They must meet the immediate demands of all out military production, and yet conform with ease to the pattern of the future as well. For defense plants will in a few years be turned over to commercial production; they will be the core around which industry will build to replace "yesterday's" plants that are adequate today but will be hopelessly obsolete tomorrow.

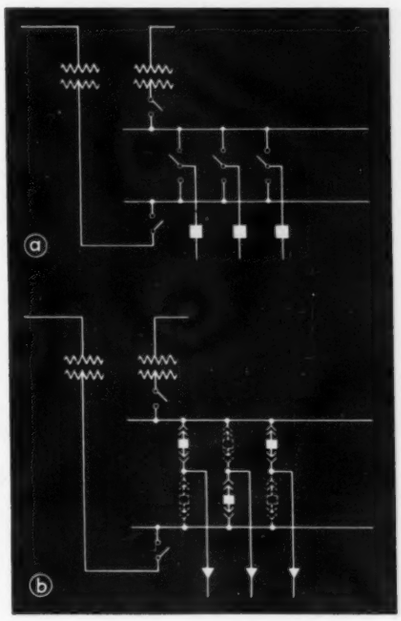
This manifest destiny of today's defense plants, then, imposes seven requirements on their electrical system design. These are:

1. *Dependability* — With defense industries operating three shifts a day for six and in some cases seven days a week, work stoppage caused by equipment failure, sabotage, mechanical damage, fire and explosion in the electrical system must be a remote possibility.

2. *Adaptability*—Changes in the arrangement of production lines and the likelihood of today's military airplanes becoming tomorrow's commercial planes implies ability to rearrange machines and shift load concentrations at will without major alterations to the power system.

3. *Extensability*—Increases in production rates, either during or after the present defense emergency, demand that power systems be able to meet increased demands quickly—through quick, foolproof expansion.

4. *Unity*—A clear, unified concept of the relative importance of various elements in the power system is basic to the whole design pattern.



SCHEME I. a and b — Separate high-voltage lines serving separate buses each supply half the plant load.
Intermediate voltage feeders tap the buses through either (a) double-throw disconnect switches or (b) through breakers which can be shifted from one compartment to another.

5. *Consistency* — Adherence to established objectives from the incoming lines to the last control station—with no lapses or bottlenecks is a fundamental design theorem.

6. *Durability* — Performance of construction is axiomatic in industrial plants which will be the backbone of peacetime industrial production in the future.

7. *Efficiency* — Waste, either economic or physical, is inconsistent with good design under any circumstances, certainly in long-time industrial planning

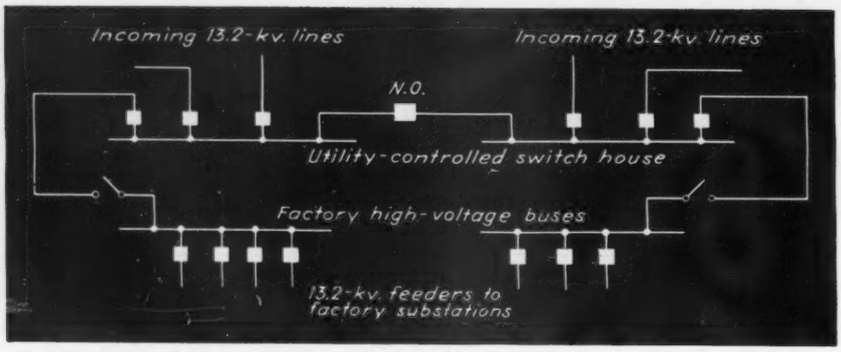
How these characteristics influence design affecting (1) high-voltage power supply and switching, (2) distribution to factory substations, (3) substation layout and switching, (4) coordination of protection and (5) low-voltage distribution to production machines, is discussed in this and following articles on electrical engineering in defense plants designed by Albert Kahn Associated Architects and Engineers, Detroit, Mich.

High-Voltage Supply

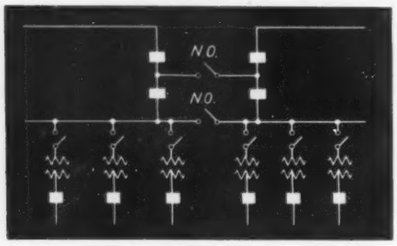
Defense plants are being supplied at voltages ranging from 13.2 to 120 kv. Duplicate supply sources—taken from independent points on utility systems—are the rule. While two supply lines are generally satisfactory, four have been resorted to where voltage was too low to allow supply to be restricted to two lines.

Manner in which high-voltage supply lines are operated depends largely on utility system conditions and the needs of other utility customers. Two arrangements of supply lines are commonly employed—(1) separate operation, each line independent of the other or with provision for switching entire load to either line on a preferred-reserve basis, (2) separate operation, with

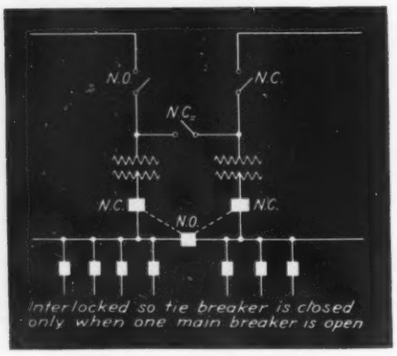
* Electrical engineer.



SCHEME II — Four intermediate voltage supply lines operating in parallel, with switching under utility control, serve one defense plant



SCHEME III — Separate supply lines can be paralleled in emergency through this arrangement used in an airplane engine plant



SCHEME IV — Duplicate supply sources with the plant load served normally from one line. Switching load to reserve line is done by automatic motor-operated disconnect switches

parallel operation possible with permission of utility load dispatcher. Parallel operation is rare; only one case will be discussed.

Incoming lines at most plants are connected to some form of sectionalized bus system either before or after transformation to a lower voltage, usually of the order of 4,000 volts. In almost all cases each bus section or transformer bank is capable of carrying the entire plant load continuously. Interconnected sectionalized bus and associated switchgear are simply a means of switching load from one line to the other.

Rather than keep one bus and associated transformer bank as "dead reserve," plant load is often split between the two lines and bus sections. Too frequently equipment in "dead reserve" cannot be operated when needed. With load divided and both bus sections operating at all times only half the load will be "lost" with failure of either line or bus, and then only as long as is required to transfer all load to the unfaulted circuit. Using the dead-reserve idea, with the preferred line down, the entire plant *might* be "down" for a whole shift or longer, before the standby line could be loaded.

Sectionalized Bus Scheme

Five different variations of the sectionalized bus scheme used under different conditions for bringing high-voltage service into defense industrial plants are illustrated.

Scheme I—This arrangement is used where the utility system conditions and service to other customers makes it desirable to operate the two supply lines independently of each other. Each line is therefore brought in through a transformer bank and disconnect switch to a separate bus, to which half of the plant intermediate voltage feeders are normally connected through one of two variations of the T-type feeder connection common to central station practice. The two variations (a) and (b) are illustrated. Each has the advantage that it gives the reliability of a double-bus and throw-over arrangement with a single feeder circuit breaker.

An arsenal, for example, used arrangement I (a), employing a double-throw disconnect switch to connect plant feeders to either of the two buses. Before changing the switch position feeder load is broken on the single feeder oil circuit breaker. The feeder can be completely removed from service by opening the selector disconnect switch and the "load side" disconnect switch.

Compartment Mounting

A motor car manufacturer resorted to the slightly more expensive yet more expandable arrangement I (b), in this case metal-clad switchgear compartments were put back to back with the feeder riser between. Each compartment gave access to one of the two buses, but only one compartment was equipped with a breaker. When it was desired to shift the feeder from one bus to the other the breaker was opened and transferred on its truck to the other bus compartment and closed in on the other bus. These two positions are so interlocked that it is impossible to install a spare breaker in the vacant compartment while the other breaker is in place. The metal-clad construction *permits* application of ground fault bus protection if desired. This scheme, I (b), is, however, more expensive than scheme I (a) and has the added disadvantage that it does not lend itself to use where feeder breaker compartments cannot be put back to back.

Scheme II—This arrangement was used in a large airplane engine plant in Ohio where the size of the plant demanded the ultimate in reliability of service. Two sets of two medium (13.2-kv.) voltage lines from two different sources were brought in parallel through breakers to separate buses in the switchyard, which were connected by a tie breaker. In general, parallel operation of high-tension supply lines is avoided in defense plants. In this case, however, the medium (13.2-kv.) voltage used permitted parallel operation of lines without danger of unstable operation. Four lines were required at this voltage; to carry the load of this plant two were not enough.

Load Increase

As the load in this plant grows it is proposed to raise supply voltage to 66 kv. and supply the two separate buses from individual lines, doing away with parallel operation. A separate medium-tension switching

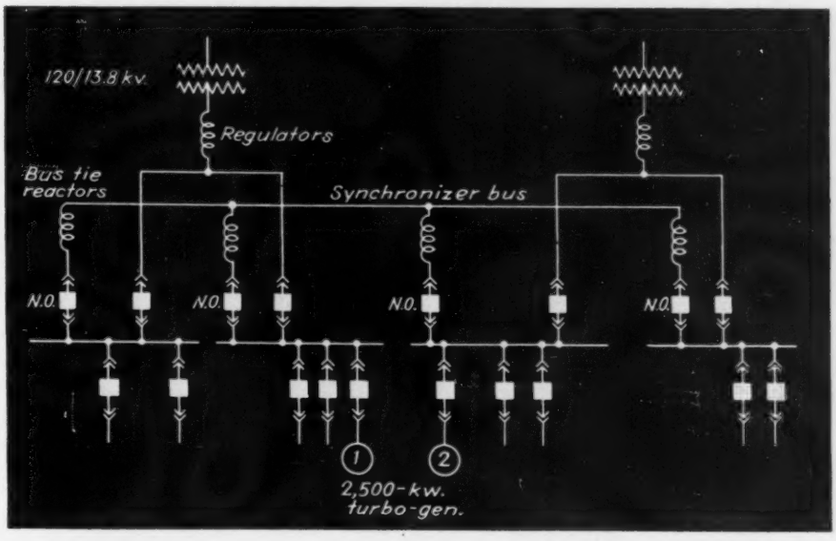
station was resorted to here so that the power company could control switching between the four supply lines again for reasons of service to other customers. A separate feeder from each "utility" bus supplies two plant medium-tension buses through a disconnect and breaker arrangement. Either plant bus has sufficient copper capacity to serve the entire load. One high-tension feeder from each plant bus passes to the same two (of several) substations in the plant, although only one substation is normally connected to any feeder. This arrangement will be explained in detail in a subsequent article.

Savings

This system is more than ordinarily flexible. Switching and transmission to all plant substations is at line voltage (13.2 kv.), since the plant is large and the load heavy. Medium-voltage transmission to load centers in the vicinity of each plant substation saves in losses more than the increased cost of the medium-voltage equipment. In general, this system of medium-voltage service is not recommended for small or medium-sized plants. Its application is best restricted to large plants with scattered heavy loads, where maximum service availability is essential and where electrical personnel is highly skilled.

Scheme III—Where the power company, for reasons of service to other plants, wishes to operate its two high lines separately, but still be able to connect them if need be, some such scheme as III is used. The arrangement was recently used in supplying an airplane engine plant. Here the lines were connected through a normally open disconnect switch ahead of the point of connection to the sectionalized bus. The sectionalized buses are connected through a normally open disconnect switch. For convenience in switching, when trouble occurs on either bus and to make it easier to operate the two lines separately on isolated buses, four breakers—two on each line on each side of the tie disconnecting switch—are provided. More costly, but it gave the power company the added advantage of being able to supply other companies through entire line.

Scheme IV—An arrangement that has the advantage of duplicate supply sources, but which avoids the additional investment required to carry the duplicate service idea throughout, was incorporated in an airplane parts plant. This scheme, which is suitable for small plants where reliability requirements are not as stringent as in others, uses only one of the two lines to supply the plant. Either manual or automatic, motor-operated "preferred-reserve" disconnect switches can be used on incoming lines. The preferred line serves both the lighting and the power transformer banks. Each of these banks is tied to a separate bus through normally closed oil breakers that are interlocked with the tie breaker between buses. The tie breaker can be closed only when one transformer breaker is open. Under this condition (one transformer breaker open) there is sufficient capacity in the remaining bank to supply essential services.



SCHEME V — Where there is incidental generation within the plant this synchronizer bus provides means of paralleling generators and supply lines

Scheme V—Where incidental generation exists within the plant for "standby" service, as is the case in a bomber plant, some such bus arrangement as Scheme V must be provided so generators may be synchronized with either or both supply lines for parallel operation. In this case each of two 120-kv. high lines supplies two of four separate medium-voltage buses. Two of these four 13.8-kv. buses are connected to 2,500-kw. plant turbo-generators. A synchronizer bus, tie breakers and reactors provide the means for tying the four bus sections together.

Obviously, the larger the plant and the more generators and bus sections involved the higher will be the cost of such a system, because of the number of high-voltage breakers required and the extent of the synchronizer bus. Also, unless bus tie reactors are provided, the interrupting capacity and cost of breaker equipment will be excessive, although their operation may be infrequent.

In the case of the bomber plant the two 120-kv. utility supply lines normally supply two separate 13.8-kv. bus sections through a 120/13.8-kv. transformer bank and line breakers on each bus section. The synchronizer bus provides a means of tying all four bus sections or any combination of bus sections together. Either line and the plant turbines can be paralleled or both lines and the turbines may be paralleled.

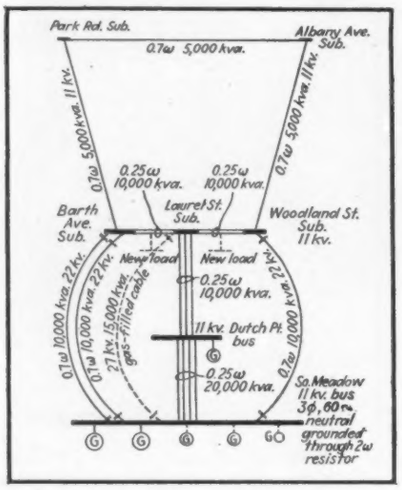
Besides higher cost, however, this type of switching arrangement requires more than the normal amount of floor space and building volume in the primary switch house for the bus work. Where the electrical department is charged "rent" for space used by system elements this may be a factor in operating cost.

Scheme V is flexible. However, to secure this flexibility, switching operations must be properly coordinated. The system demands a high type of operating personnel. The degree of flexibility provided presumes the intelligence necessary to apply it to advantage. Thus, in this case, operating personnel might be said to exert an influence on system reliability.

Gas-Filled Cable Meets Urgent Load Situation

Rapid growth of demand in Hartford area burdened existing cable facilities — Limited duct capacity utilized effectively

INCREASING load demands, imperative and immediate, for some 11,000 kva. in certain semi-outlying districts required the Hartford Electric Light Company to provide additional feeder cable facilities late in 1940 between its South Meadow generating plant and Laurel Street substation. After analysis of the limitations of the existing duct lines and capacities of existing feeders it was decided to install a 27-kv. gas-filled cable of the three-conductor type to provide an additional 15,000 kva. for this area. This departure from the company's previous practice has proved highly satisfactory during nearly ten months' service and will be utilized in other instances where the engineering conditions justify it.


Park Rd. Sub.
Albany Ave. Sub.
0.7ω 5,000 kva.
0.7ω 5,000 kva. 11 kv.
0.7ω 5,000 kva. 11 kv.
0.25ω 10,000 kva.
0.25ω 10,000 kva.
Laurel St. Sub.
Barth Ave. Sub.
Woodland St. Sub. 11 kv.
New load
New load
0.25ω 10,000 kva.
0.7ω 10,000 kva. 22 kv.
0.7ω 10,000 kva. 22 kv.
27 kv. 15,000 kva. gas-filled cable
0.7ω 10,000 kva. 22 kv.
11 kv. Dutch Pt. bus
0.25ω 20,000 kva.
So. Meadow 11 kv. bus 3φ, 60 ~ neutral grounded through 2ω resistor

SCHEMATIC DIAGRAM of feeders serving rapidly growing district with new gas-filled cable tie from generating plant

Design characteristics of gas-filled cable are now generally well known in the industry. The experience of the Consolidated Edison Company, New York, has been covered in ELECTRICAL WORLD, March 11, 1939, page 92, and September 6, 1941, page 47. Hartford's application is of interest in relation to the fitness of this type of cable to the problem in hand, the installation and operating aspects.

The territory supplied by the group of feeders concerned is about 4 by 5 miles in dimensions in Hartford and West Hartford, with minor branches extending much further. The load is well diversified, with an excellent load factor, and of first importance are two large hospitals, some 25,000 domestic customers and such large industrial customers as the Pratt & Whitney Division of Niles, Bement Pond machine tool makers, Royal and Underwood typewriter plants, Billings & Spencer, Pratt & Cady and numerous commercial customers ranging from the Aetna and Hartford fire insurance companies down to the corner grocery.

In May, 1940, this load totaled about 25,000 kva., and a predicted demand of 30,000 kva. for two hours was fulfilled in November. The existing capacity to serve this load was about 40,000 kva. at normal cable rating. As the largest cable unit had a capacity of 10,000 kva., the situation appeared well in hand for another season.

According to the engineers of the company, loads increased at one time at locations convenient to the schematically diagrammed layout. Before the recent expansion of load, the several cables, despite the handicap

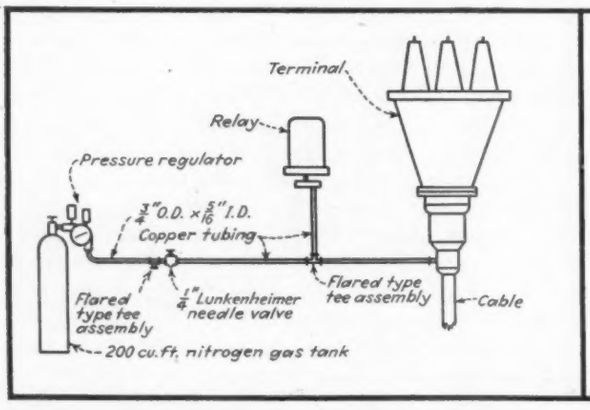
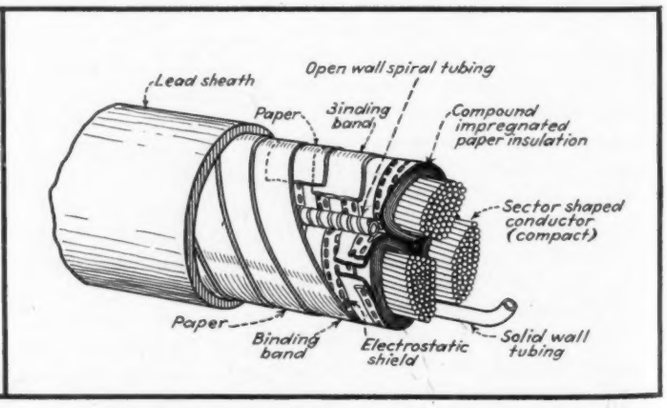


DIAGRAM of gas supply, relay and piping connections at cable terminals



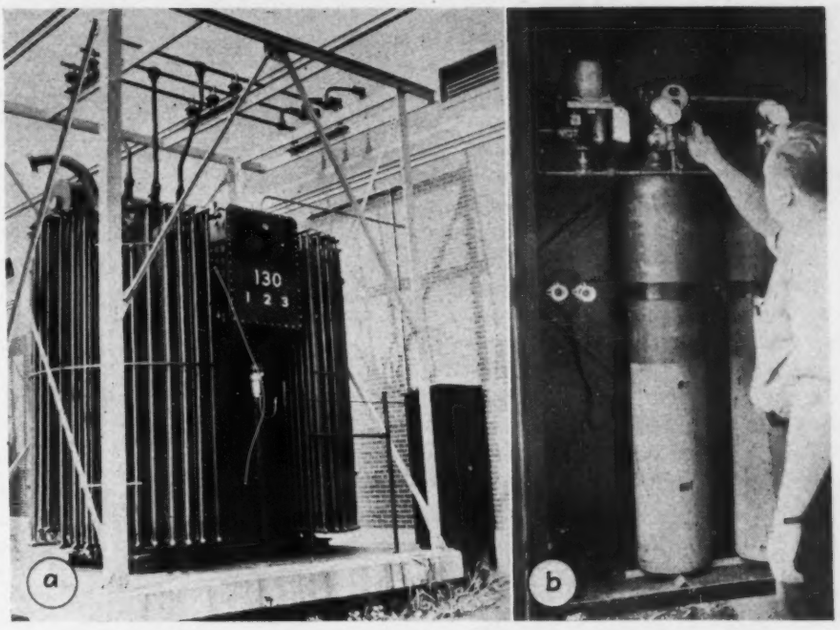
PERSPECTIVE DRAWING of 27-kv., 3-conductor gas-filled cable make-up

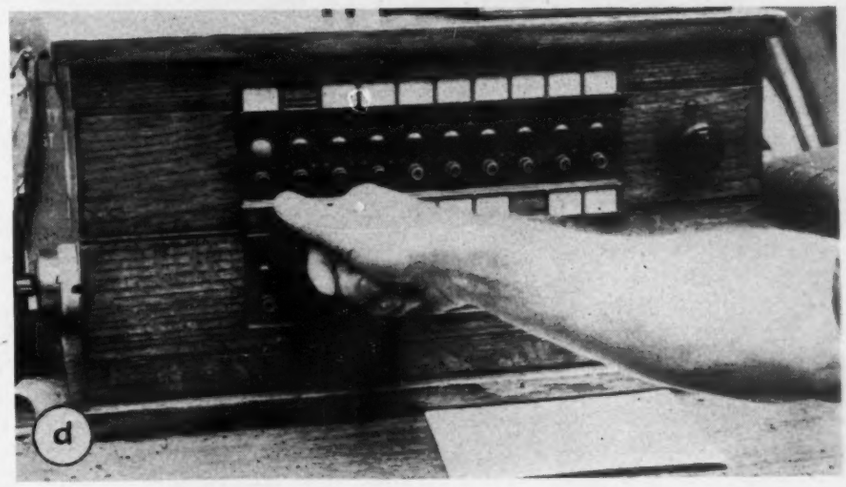
of auto-transformers and reactors, shared the load each according to its ability, barring the cluster of small cables between Dutch Point generating station and Laurel Street substation, which frequently picked up more than their fair share. Even this trifling disaffection seemed in a fair way to be corrected as more and more heavy industrial plants abandoned their outgrown shells near Laurel Street for locations elsewhere. Then destiny suddenly went into reverse.

Additional demands for about 11,000 kva. threatened the group of small cables mentioned with sudden death and three larger cables with intolerable overloads. The situation appeared to require a 15,000-kva. cable. While a 33-kv. cable would have been a welcome solution, the splices would have been too large for the available manholes. Only one unoccupied duct remained in a few sections of the route chosen, and ducts varied in cross-section, in some places having not more than 3 in. clear diameter. Banks consisted of single tile, concrete-encased, and multiple tile with and without encasement.

Designs of Cable Considered

A 27-kv. General Electric gas-filled cable was selected for the job, but before purchase six other designs of cable were considered, as follows: 750,000-cir.mil, 23-kv., gas-filled, 2.95 in. outside diameter; 600,000-cir.mil, 23-kv., solid, 3 in.; 900,000-cir.mil, 23-kv., gas-filled, 3.02 in.; 700,000-cir.mil, 23-kv., solid, 3.137 in.; 500,000-cir.mil, 27-kv., solid, 3.03 in., and 350,000-cir.mil, 34.5-kv., solid, 3.10 in. All six were outlawed by the mechanical limitations of the ducts. Oil-filled cable had the further disadvantage of higher cost in addition to mechanical restrictions as to splice lengths and space for reservoirs.





GAS-FILLED CABLE serves rapid load growth in Hartford

(a) Start of 27-kv., low-pressure, gas-filled cable system at South Meadow station, showing cable leaving transformer with pipe connection to locked cabinet at right containing gas-pressure regulating equipment and nitrogen cylinders.

(b) Interior of outdoor cabinet at South Meadow station showing gas-pressure relay at left, nitrogen cylinder and pressure gages in center, and standby cylinder at right.

(c) Cable joints in manhole. Bottom joint is for 27-kv. gas-filled cable; other joints above are conventional joints for 11-kv. solid type cables.

(d) Annunciator in control room of South Meadow station which automatically indicates existence of subnormal gas pressure. An alarm bell rings under the desk simultaneously with the annunciator indication.

Approximate costs of solid-type, gas-filled and oil-filled cable were given by V. A. Sheals, assistant designing engineer, cable engineering department, General Electric Company, before the Underground Distribution Engineers of New England, at Hartford, prior to the initial operation of the 27-kv. gas-filled cable.

At Hartford there was an approximate limit of 8 watts per duct-foot to keep within the heating requirements of the insulation. Manhole temperatures were already 98 deg. maximum, and manhole lengths were 6 ft. and 8 ft., leaving none too much space for racking or for sliding a sleeve back and forth during joint construction.

Two Cross-sections Used

The Hartford company purchased 18,649 ft. of three-conductor, gas-filled, 27-kv. cable, including 5 percent extra length for future maintenance. Because of the concentration of cable capacity, load and heating conditions out of the South Meadow station, the first 2,100 ft. is 600,000-cir.mil. The rest of the line is 500,000-cir.mil. The entire cable is of type H design, with 0.24 in. of paper thickness. The 500,000-cir.mil section has a maximum calipered diameter of 2.78 in., with 0.133 in. thickness of lead sheath and the 600,000-cir.mil a calipered maximum of 2.91 in. and 0.141-in. lead sheath. The 600,000-cir.mil length was laid in 4-in. duct and the rest in duct ranging in diameter from 3 to 3.5 in., rodded for 3.25 in. with a 12-in. mandrel.

The line has 58 joints. It terminates in three-conductor terminals mounted on auto-transformers and is protected from low or high pressure by means of a gas-pressure relay at each end, giving alarms at predetermined limits. A 200-cu.ft. tank of nitrogen gas is permanently tied into each end of the line to provide for seasonal adjustments of gas pressure and to furnish an emergency supply in case of leakage. The relays are set for about 14 psi. maximum working pressure. Normally the gas cylinders are shut off from the cable.

The cable was shipped full of nitrogen gas at a predetermined positive pressure and was installed without contaminating the gas in the cable. No vacuum treatment was required. The cable manufacturer furnished an engineer to aid in the field work, with complete written instructions as to procedure, this being Hartford's first installation. Shipment was by standard reel, the seal end of the cable being made available for pressure reading by means of a flexible lead pipe extending from the seal end into an opening in the reel flange. Pulling bolts were provided (no wiped-in pulling eye being required), the bolt being hollow and sealed with a cone-point set-screw to enable nitrogen gas to be supplied from the end. The permitted range of gas pressure was between 12 and 2 psi. during construction. Maximum pulling limit allowed was 10,000 psi. of total copper cross-section, or 5,000 psi. of lead sheath cross-section, whichever was smaller.

Tentative Comparison of Cable Types

	Solid	Gas-Filled	Oil-Filled
Stress in volts per mil, avg.	42-58	52-70	80-143
Insulation thickness for 27 kv., in.	0.297	*0.0240	0.160
Outside diameter, 500,000 cir.mil, for three-conductor, 27 kv., in.	3.05	2.8	2.55
Approximate installed cost per kva. of power transmitted, in percent† at 27 kv.	100	‡105-110	115-130

* Tentative thickness, still somewhat experimental.

† These figures may vary due to local conditions.

‡ Based on meager information, but it is anticipated by the manufacturer that these figures can be reduced by 2 to 5 percent.

Control of gas flow and gas pressure during installation was supplied from portable nitrogen cylinders temporarily connected at certain points along the line. These connections were made to the cable ends or to fittings provided on the joint casings. Flow resistance curves were utilized to check the condition of the gas feed channels in the cable lengths and two types of temporary end seals used to prevent undue loss of gas from exposed cable ends in jointing or terminal work. Sponge rubber was used to form sealing plugs for the spread cable ends, with metal binding bands. The gas pressure was raised to normal (about 12 psi.) after completion of the installation.

The construction division of the Hartford company states that the average time per joint constructed was about twelve hours. Pulling was done by a seven-man cable crew and the job averaged four splicing crews of a splicer and helper each. A fifth splicing crew was used in early morning and late afternoon in connection with the relocation of gas tanks. Cable joints were protected against failure due to possible high internal pressure by wrapping the entire joint sleeve with a $\frac{1}{8}$x2-in. impregnated woven cotton tape, the lead sleeve itself having been protected by a bituminous compound. The entire cable sheath within the manhole was painted, and this was followed by applying paraffine impregnated cheesecloth 3 in. wide with a slight lap. On this was applied a 1:2 mix of cement grout $\frac{3}{8}$ in. thick, held in place during application by non-impregnated cheesecloth, and finally smoothing off with a bit of thin grout and the fireproofing's own moisture. Cable lengths laid ranged from 150 to 550 ft., with a 275-ft. average.

The cable was repeatedly tested for gas pressure during construction, but in only two cases did the pressure in any section at any point fail, this being due to leaks. Insulation was tested by a 75-kv. d.c. kenotron set. No interruption of service had been experienced in the first nine months' operation. In one instance a ground relay developed minor trouble due to residual magnetism, giving a low-pressure indication. Besides the alarm relays for drop or rise of pressure installed at Laurel Street and South Meadow, provision has been made for signal transmission from the former point over a supervisory circuit to the attended substation at Pearl Street, a major distribution center in the downtown area.

Summary

To sum up, the primary advantage of the gas-filled cable at Hartford under the physical and economic conditions is the ability to run the dielectric strength of the cable to a point about half way between that of a solid and an oil-filled cable, taking advantage of the larger carrying capacity thus available per duct due to the reduced paper thickness for a given outside diameter. The duct limitations, as indicated, were severe. Some benefit also accrues from ability to anticipate and locate faults through gas leakage, monthly readings being made of gas pressures at each end. It is not the company's practice to overload its cables, and consumers' service is widely insured by duplicate feeder facilities against interruption by a single cable failure.

Quiz Programs Enliven Safety Meetings

Contestants point out "What is wrong in this picture" and are graded for prizes on speed and accuracy in spotting infractions of safety rules

EDWARD C. HUNT,* Pacific Gas & Electric Company

WARS come and go in the world's history, but the war against accidents must go on forever. To curb the toll of life and limb and stem the tide of property damage and lost time is a task that taxes the ingenuity of the safety engineer. Not the least of his jobs is directing educational programs that will continuously keep the "Safety First" idea uppermost in the minds of employees.

Most popular educational activity yet developed by the Pacific Gas & Electric Company has been a "quiz" type program, patterned after some of the radio shows. Its latest adaptation incorporates a series of "What's wrong with this" pictures that are featured in the annual safety meetings held in each of the company's fifteen divisions. The success and popularity of this activity indicates that here is a valuable method of imparting accident prevention information.

For many years the central safety committee has provided each of the company's fifteen divisions with a program for a general rally or "annual division safety meeting." These are held at night and are attended by employees and their families as well. It has been a difficult task to provide variety and originality for these meetings. Many different methods have been employed but the main effort has been to keep away from stereotyped speeches. One year the program was built around actual demonstrations of various types of tools and their uses, together with colored motion pictures that enlarged upon the demonstrations.

In 1940 a "quiz" program was developed around the company's safety rule book. Preliminary preparations included efforts to encourage study and review of the safety rules and regulations which were followed by elimination contests in each division to select two teams or crews to take part in a final quiz at the annual meeting. These teams consisted of three men each and prizes were awarded to the winners.

So effective was this program in creating discussion of safety procedure that the central committee agreed that repetition was desirable in view of the benefits to be derived. For the 1941 contest a series of "haywire" pictures were taken in the field. These were staged by men in the various departments and showed job operations being performed contrary to safety rules and regulations or contrary to common safety practice. The pictures were taken on 28x44-mm. Kodachrome film which was mounted for use as lantern slides.

Slides Shown at Meetings

In the meetings the slides were projected onto a screen sufficiently large so that the entire audience could view the picture. Microphones and loudspeakers were used for the "quiz professor" and the contestants. Purpose in each instance was for a contestant to name all of the safety violations or rule infractions in each picture. Each of the three contestants on each of three teams reviewed two different pictures and each was given a grade based upon his accuracy in citing all

[*Continued on page* 107]

*Safety engineer.

WHAT is wrong in these pictures?

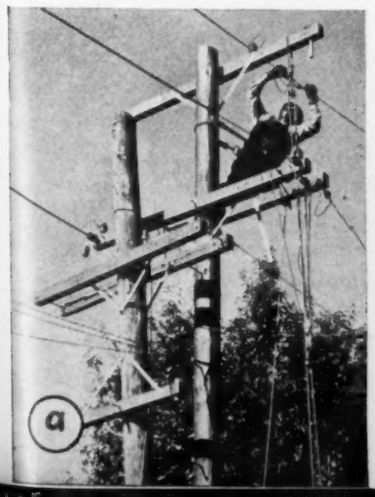
Samples of the 100 or more Kodachrome shots used in safety quiz program. Each picture shows one or more infractions of safety rules.

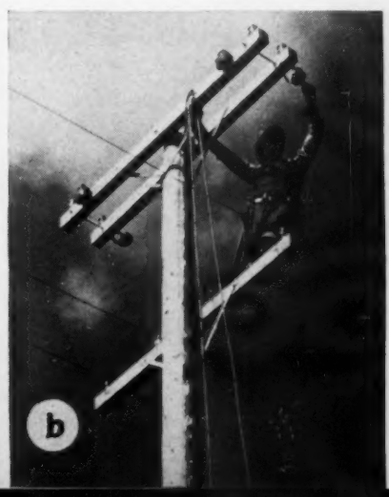
(a) The lineman is working alone on high voltage. No rubber gloves or other protection and new pole is improperly supported.

(b) Safety belt not used.

(c) Changing fuses on telephone circuit paralleling high-voltage line, workman forgets to use rubber gloves, neglects to set ladder on insulating stool and fails to open disconnect switches.

(d) Work on 440-volt controller requires rubber gloves and care against grounding, as hand holding cover open.





Editorials

S. B. WILLIAMS, *Editor*

Resumption Diversity Warrants Consideration

QUITE A BIT is known about the diversities that can be expected under normal conditions of loading, but considerably much less is known about the diversities that exist when service is resumed after an interruption. Generally speaking, radial circuits and transformers are pretty sure to have the short-time thermal capacity to stay with the task of resuming the load. The concern ought to be more on the side of voltage sufficiency and the risk of starting failures of connected equipment.

Motors have a habit of requiring much more current to accelerate than to carry their load, and unless they have been provided with correctives, the current lag accentuates the voltage drop through circuit reactance. This voltage drop is usually insignificant when motors start and restart at diversified intervals on a circuit that is continuously energized. But what are those intervals and how long can an interruption last before the start-interval diversities are lost and many of the motors are all set to start when the circuit is reenergized? What is the degree of preponderance of motor load that may emphasize still further the tendency toward greater drop than goes with continuity of tungsten filament normal loading? How much are these conditions accentuated by tungsten filament lamps with a starting current twenty times running current?

Protective measures may well have been provided to reduce the likely number of interruptions to a low value. But increased loading and the new threats of damage from human malice or from the air warrant consideration of this question if only to ascertain where the weak spots are as to circuit resumption and to reduce the loss from damaged motors that hang on their starting cycle because of low voltage.

Perhaps the distinction between normal diversity and restarting diversity warrants use of the term "resumption diversity," and, if it does, we need to know how much it does differ and what to do about it. Designers of secondary networks know from experience that there is such a thing and what to do about it.

Labor's New Tactics

EVER SINCE the public uprising in Kansas City caused by the recent strike that closed down electric service organized utility labor has changed its tactics. While one can never definitely predict what labor will not do, there are reasons to believe that the unions will hesitate for a long time before they again take the responsibility for pulling a switch and putting human lives in jeopardy.

That does not mean that we can expect labor to reduce the pressure for recognition, wage increases, improved working conditions or closed shop. Nor does it mean that there will be no more strikes. Companies can be embarrassed by work stoppages that do not deprive the public of electric service or that do not shut down defense industries.

But another more subtle operation has appeared recently which has made a tremendous impression on labor leaders. That is the taking of the story of labor to the public through paid advertising. This sort of thing differs greatly from the ordinary newspaper stories giving both sides of a labor controversy. These advertisements are selling the cause of the workers. They are prepared by good copy men.

It may be too late to try to combat such publicity after it has appeared. It would be far better to tell the public the company's side of its labor problems regularly. In fact, this might be the only way of getting the ear of the employees. This, of course, is all on the presumption that the company has a case that will hold water.

The war has not stopped labor pressure. Everything appears quiet for the moment, but that may not last long. Labor will be the first to catch any effort made to take advantage of the war situation to take away anything from labor. Employers must keep on their good behavior just as much as labor.

Mercury Cycle at Maturity

AFTER some three decades of discouraging obstacles, overcome only by persistent faith on the part of a few and by unrelenting research on the part of many, the mercury-vapor boiler and prime mover system is ready to go, technologically and practically. The recent A.S.M.E. convention was made the occasion for recording the fruition of improvements that render the process quite definitely safe, sound and feasible. Power generation can now confidently accept the mercury cycle as a practicable incursion into realms where the steam cycle shows signs of reaching a plateau of diminishing returns.

Most of the troubles that impeded the arrival of mercury at maturity are now sensed to have been matters of feed treatment. Feedwater treatment for steam systems has become a science with sound diagnosis and predictable remedies. Feed-mercury treatment by minute injections of magnesium and titanium has now been found to solve the problems of insufficient surface wetting and of the consequent digestion and migration of iron that made

mercury boilers for long a matter of uncertain reliability. Assurance by operators and designers alike has now been given that the mercury system is safe, reliable, readily maintained, not to mention that it is alluringly efficient from the thermodynamic viewpoint.

Assurance is further given that costs per kilowatt when normal conditions return will favorably stack up against higher pressure and higher temperature steam. Mercury supply and cost are expected to be no obstacle and metallurgists promise the alloys for the higher temperatures that mean so much more in thermal efficiency than pressure, particularly with mercury. There is now sound reason for the expectation that the cycle will find steady adoption in the superposition field.

Mercury superposed on 600 psi., 730 F. steam will produce for the same steam flow, it is stated, nearly four times as many kilowatts as superposing with 1,200 psi., 925 F. steam and well over twice as much as 1,200 psi., 925 F. steam over 350 psi., 635 F. steam. Give mercury the metals for 600 psi. and 1,500 F. and the claims are that it would be equally attractive as a cycle riding atop the present installations of 1,250 psi., 925 F. steam.

Successful completion of the mercury-cycle development is a monument to the vision and tenacity of William LeRoy Emmet, who died only a few months before this much could be said publicly about it. It is equally a monument to his employer, his associates, those who developed the boilers and the Hartford and Newark utility executives and engineers who stood the onus of the experimentation so that power generation by fuel might cross one more frontier.

The First Electrical Engineering Students

EARLIER this month there was celebrated at Princeton University the fiftieth anniversary of the graduating of the first class in the first formal school in electrical engineering in the United States.

When this school of electrical engineering was started at Princeton central station service was but six years old. Telephony had just established commercial communication between Boston and New York. Alternating current was beginning to make its appearance commercially. It was in the same year that the polyphase electric motor was born.

While other colleges had been giving in their engineering schools courses in electrical engineering for three or four years, and while formal recognition to electrical engineering as a profession had been accorded by the founding in 1884 of the American Institute of Electrical Engineers, it still took vision to start a school devoted solely to this new profession and it took a lot of courage as well for those first students to gamble with their future in this manner. This courage, we suspect, came largely from enthusiasm generated by the teacher.

It was interesting to see in a biography of the founder of this school, and for many years its head, Professor Cyrus Fogg Brackett, that the courses were informal, more in the nature of conferences, in which were intermingled natural philosophy and engineering discussions of a variety of apparently non-related subjects. Politics, law, economics, religion, industrial processes and other things at one time or another were brought to the students' attention.

It seems too bad that this early attention to the other phases of human knowledge with which engineers must come in contact was to be later forsaken for more and more "practical" courses. We sometimes wonder if engineers might not have been better able to show leadership in solving our social, political and economic problems had they been subjected to less shop work and more of the broader components of human knowledge during the formative years of college education.

Conventions During the War

NEARLY a year ago, when there was some talk of postponing conventions until after the emergency was over, we urged against any such action, and now that we are in the war we hold the same point of view. The kind of programs in all likelihood will have to be changed, because this is no time to stay away from the job longer than is necessary. For that reason conventions and meetings will have to be streamlined, without time out for play.

Conventions can be extremely valuable to an industry at this time to formulate plans for group action, to set up material exchanges, to find out how others are meeting the problems arising from the war, to learn how substitute materials are working out and how effective salvage is, to get the interpretations of others on official orders, and a great many other things.

Whatever the feeling may have been in the past, the problem today is not a local one for each to solve in his own way. War is something that is common to us all and we can accomplish more by working together. Conventions and meetings provide the time and place both for joint action and for getting a broader and more complete understanding of effective ways of meeting the common problems.

What Can I Do?

There appears at the beginning of the text section of this issue a statement from the president of the McGraw-Hill Publishing Company on our responsibilities as individuals toward winning the war. This message concerns every person in the United States, and since most of our readers are in supervisory positions we are hopeful that requests will be made for copies to put in the hands of employees. In England a similar message by a large company under the slogan "It all depends on me" has been no end of help. Requests for reprints without the last part referring to McGraw-Hill should be made direct to this publication. Small quantities will be sent without charge, larger quantities at cost.—EDITOR.

Washington Comment

By GEORGE E. DOYING, Jr., Washington Correspondent

Load Factors Must Rise —and Quickly

Get more with what you have!

That's not a new slogan in this war period, but now, with the conflict actually upon us, it is no longer a goal. It is a requirement which must be achieved.

This is the temper of the Supply Priorities and Allocations Board twenty days after Pearl Harbor. It is the temper of OPM, and of the military forces. It is best summed up by the President's call for a 24-hour day, a 168-hour week.

Utilities inevitably will be a vital cog in this step-up in the war pace. Transmission lines, for instance, will be a front line for meeting the energy demands of war-born production expansion in the year that lies ahead—both by new connections and by greater loading of present ones.

So will presently unused load factors of existing power houses.

The amount of generator installation which can be made in 1942 and later is inexorably fixed, by the production time factor, for the next year or year and one-half at least. Today's figure may—and probably will—shrink by reason of greater diversions of production capacity to marine output.

OPM is already encouraging greater reliance upon transmission facilities to meet new power demands. One of the factors weighed by the Power Branch in passing upon priority applications for new construction is whether existing connections with other systems are being utilized to the full limit of their availability. Also in passing upon new construction, consideration is given to the extent to which proposed additions could be used to supply neighboring regions.

Where such evidence may have got only passive attention in the past, it can now be expected to become a very real and important factor. New projects which not only can meet a particular local problem but also back up the next-door system should get farther than those not so potentially diversified as to use.

The Southeastern power pooling, with central dispatching for generation in most of an eight-state area (ELECTRICAL WORLD, November 15, 1941, page 70) set the sights on what can be done to make high-capacity lines work overtime. There will be more mandatory OPM pools like this one in regions where acute shortages develop, but Washington feels that the opportunity exists for utilities to move in this same direction on their own.

Must Show Value

Thus the required "spell-out" by OPM in applications for project ratings, not only of the immediate particular need for new construction but, in addition, its potential regional value.

OPM Power Chief J. A. Krug feels that, at least for the immediate future, the job of finding work for presently part-time idle generation is a problem in which utilities themselves must keep the initiative. So long as the war demands for such continuous-process materials as aluminum, magnesium, etc., continue to outrun construction of new production facilities, the necessities for conserving materials used in building, Mr. Krug feels, will militate against operating schedules geared to off-peak or seasonal power supply.

The war planners simply consider that the nation cannot afford to use steel and machine tools to build any big defense plant which isn't going to be operated full-tilt all the time, so long as the nation's need for that plant's output exceeds the capacity.

But Mr. Krug does feel that there are other ways of building up load factors, to get generating capacity now only partially at work on a more nearly full-time basis. Utilities have been hard at work on this score, and have accomplished much; Mr. Krug concedes this. There are utilities whose 50 percent load factor of a year or so ago now is 85 percent.

Still more can be done, and perhaps the biggest field lies in conversion of facilities now working on civilian goods into war lines. For the most part such facilities are only part-time customers for power. Today, and for the duration, it is inevitable that many of them will be forced to curtail their operations progressively if they stay in civilian production.

Change to War Production

To date the automobile industry offers the outstanding example of a major scale conversion from civilian to war goods; so complete is the shift that private car production appears to be nearing the vanishing point. An example on a smaller scale, and therefore more pertinent to the present discussion, is the conversion of the household washer and ironer industry to making anti-aircraft machine gun mounts.

As long ago as last August the 34 manufacturers in this field banded together to participate in the defense effort. A joint committee of three industry engineers and an engineer from the Contract Distribution Division of OPM undertook a detailed analysis of the machinery, facilities, man-power, engineering and tooling equipment of each plant. A "shopping list" of defense items capable of being produced by those facilities was prepared, totaling 17 items. One of these seventeen was decided upon, an actual specimen broken down into individual components to determine the industry's ability to produce it.

Three of the 34 companies agreed to become prime contractors and were given a $12,500,000 contract by the War Department. Each of these three concerns took over supervision of one phase of the job—tooling, inspection, and purchase of raw materials. This cooperative venture is now in operation and Floyd Odlum's Contract Distribution staff is talking with government and industry spokesmen about spreading the idea into such fields as refrigerators, ranges, vacuum cleaners, office appliances, and other durable goods fields.

[*Continued on page* 108]

NEWS OF THE WEEK

Pacific Coast Organizes Blackout Procedures

Three main sectors tackle problems of street-lighting circuits and commercial lighting — Industrial blackout permits night operations — Energy sales drop 3 to 7 percent

Results of a week of intermittent blackouts up and down the Pacific Coast were manifested in the report of energy generated for the region for the week ending December 13—the increase over the same week in 1940 was only 6.8 percent, as compared with 10 percent for the previous week. This would indicate that blackouts had cut energy consumption an average of 3 percent for the various utilities. The drop varied with different companies due to local restrictions.

Most severe reduction, as might naturally be expected, was reported from Manila, where the output of the Manila Electric Co. was down 30 percent from the preceding week and 26 percent below the same week in 1940. Recently the increase over last year had been running 9 percent or better. No reports are as yet available on Hawaiian Electric Co., which serves Honolulu, other than word that none of its major facilities had been damaged.

Army Controls

Several unsatisfactory experiences were reported which should serve to guide utilities in other sections should similar conditions arise. Most serious was the initial lack of centralized authority in ordering circuits turned on or off. Army, Navy, municipal officials and civil defense officers all had different ideas and issued contradictory orders in some instances. This was finally changed when full authority was placed in the hands of the Army.

A severe operating problem that aroused unjustified and unfair criticism in Los Angeles was the control of some 800 separate ornamental street-lighting circuits involving 60,000 lights scattered over 450 square miles. These lights are normally controlled by astronomical clocks connected to each circuit. In the first major southern California blackout they were not turned off in many instances due to the inability of Bureau of Power and Light workers assigned to the task of pulling the switches of reaching their destinations. Their automobiles were stopped by soldiers, police and congested groups of citizens. Although the men bore proper credentials, in many cases they were forced to leave their cars standing in the street and were themselves forcibly detained.

As the initial alarm over possible raids from carrier-bivouacked planes subsided, some of the original stringent restrictions regarding sign and decorative lighting were modified. A new blackout ordinance in San Francisco permits all such lighting provided the circuits are manually controlled and someone is available to turn them out within a few seconds after an alarm. The same will hold true for Christmas decorations.

Virtually all industrial plants working night shifts have installed blackout provisions so as permit night operation even through an alarm. Exceptions are the major shipyards, where work is outdoors. Blackout materials were cleaned out of stock in short order during the initial rush.

Portland Blackouts

Blackouts in the Portland, Ore., area during the first few nights of the Japanese war cost the utility companies of that city the loss of kilowatt-hour sales approximating 6.7 percent. Portland General Electric Co. and Northwestern Electric Co. with an average combined daily output at this time of the year of 4,500,000 kw.hr. reported a daily drop off in output December 1 to 5 of about 300,000 kw.-hr.

When nightly blackouts were discontinued December 15 this load did not immediately come back in full for the reason that citizens and businesses having signs and other outside lighting were required to turn off such lighting early in the evening against the possibility of the calling of an emergency blackout during the night. Later these restrictions on outside lighting were lifted provided users were equipped to blackout their premises within ten minutes notice. This liberalization of restrictions, however, was still a deterrent to the full use of signs and

Blackout Briefs

Complete blackouts are not considered necessary in Australia, it was reported this week, and controls over lighting in coastal towns will be known officially as "brown-out."

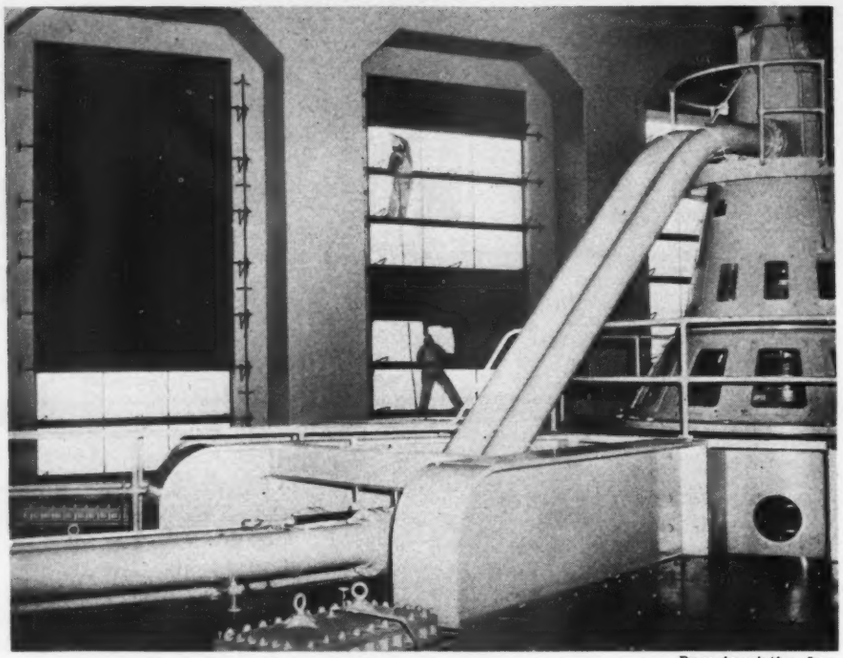
Pennsylvania has banned practice blackouts unless approved by the State Council of Defense and the First Interceptor Command.

Consolidated Edison has shown in full-page newspaper advertisements how to blackout windows of houses and offices.

Transformers at Fort Dix, N. J., are protected by sandbags piled 15 ft. high.

Armed guards are now patrolling Norris Dam.

Portland General Electric is organizing its facilities so all street lighting may be cut off within ten minutes if there is need for a blackout.



Press Association, Inc.

PREPARING FOR BLACKOUT—In an effort to blot out guidance to possible enemy bombers, windows are painted in the generating plant at Bonneville Dam

some window lighting, so that output and demand during the night hours is still somewhat off from normal.

It was necessary for the companies in the early stages of this blackout experience to cut off certain street-lighting circuits in the early evening. Now control circuits for some of these are being installed to outlying substations, where by relays these circuits can be controlled from major substations that are manned 24 hours a day. Thus are the companies improving their service under conditions calling for prompt emergency action.

Blackouts which started on the second night following Japan's entry into war have been extremely costly for British Columbia industries. Official government orders said that blackouts will be continued until further notice and coastal authorities stated that danger was at hand and hostile planes were expected off the coast. It is generally believed, however, that these reports were merely used to create an impression on the part of the public that these blackouts were genuine, and that once all necessary steps had been taken so that a complete blackout is possible when necessary the restrictions will be relaxed.

In the case of many B.C. industries, however, a blackout is an impossibility. For example, the shipbuilding industry, the sawmill industry, the pulp and paper mills and many other plants cannot blackout their operations.

During the first nights of the blackout all shipyards came to a standstill, refuse fires were dampened down in more than 40 sawmills and presses in five of the largest pulp and paper plants on the coast rolled to a stop.

Factories that could convince air raid wardens of their ability to operate without showing exterior light were given permission to run their usual schedule, but very few of the larger industrial concerns were able to comply with these requirements.

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Commission Orders Restricted Services

Further restrictions on gas, water, electricity or telephone service to non-defense users have been placed in effect by the California State Railroad Commission. Orders have been issued to all utilities to file a supplement to their service connection rules which would in substance say that all such rules have been suspended or modified to comply with national defense laws and orders.

The order is an interim ruling pending a complete investigation of the situation by the commission. Under it utilities are directed to furnish service connections to non-priority holders in the following order: (1) Connections not needing line extensions; (2) connections with the least material requirements; (3) connections which can be made within the free footage allowance of the line extension rules, and (4) without approval of the commission, no extensions outside of existing service areas or to new subdivisions prior to building therein.

NEWS BRIEFS

ARC WELDING, strangely enough, gains recognition for the part it is playing in the war effort of the Union of South Africa by the issuance of a postage stamp depicting a welder using modern shielded electric arc equipment and dressed in protective head shield, gloves and other special clothing.

VILLAGE OF ILION, N. Y., which operates a municipal electric plant, has filed notice with the state Public Service Commission that a dividend of 15 percent will be distributed on consumers' bills rendered for service during the twelve months prior to January 31, 1941. The dividend, which amounts to a refund on 1940 bills, will total $17,830.

A TESTIMONIAL DINNER was given recently by the Ohio Edison Co. at the Akron City Club in honor of Elton G. Dunlap, treasurer of the company since its inception. The event marked his fortieth year in the public utility field. A. C. Blinn, Ohio Edison president, was toastmaster and presented to Mr. Dunlap a gold watch. Friends and business associates from Akron, Youngstown, Springfield and New York attended the affair. Mr. Dunlap entered the utility field in 1901.

HOME LIGHTING AS AN ANCHOR TO WINDWARD in post-emergency times formed the background of a Central Maine Power Co. load-building conference held recently at Augusta. A. T. Littlefield, commercial manager, emphasized the continuous availability of such equipment and service in launching a long-range domestic lighting promotion program on a conservative basis.

YULETIDE LIGHTING CONTEST sponsored annually by the Electric Association of the Niagara Frontier for the past fourteen years has been suspended this year because of the emergency.

UNIFORM RATES TO CUSTOMERS served under similar operating conditions must be submitted by the Arkansas Power & Light Co. within 90 days, the state Public Utilities Commission has recently ordered. Classifications to be affected are oil field pumping, relift and reservoir pumping, cottonseed oil mills, rice and feed mills and large industries.

STATUE OF LIBERTY TORCH will soon be equipped with three of the newly developed 3,000-watt mercury vapor lamps, replacing 1,300 watts of incandescent. Westinghouse people who made the installation said this type of lamp will soon be used for highbay lighting in defense plants.

Public Power Advocates Organize Association

Nation-wide super-service company and trade association projected for municipal plants and REA cooperatives — Action follows House approval of $150,000,000 RFC fund

A broad new public utility ownership organization has been set up in Washington under incorporation papers which make it potentially a nationwide super-service company and trade association in the public power field.

Called the American Public Power Association, the group filed incorporation papers in the District of Columbia to supply service in matters of management, operation, engineering, design, construction, research and legal policy for public utility operations. Leaders of the new organization announce a membership goal of 3000 municipal operations and more than 800 REA cooperatives (the 1937 census reported 1,860 municipal electric plants) and state activities will be on a non-profit and non-political basis.

President of the APPA is James D. Donovan, head of the Kansas City Municipal Light and Power Plant, Kansas City, Kan. Other officers are E. F. Scattergood, from 1909 to 1940 manager of the Los Angeles Power and Water Department, vice-president, and E. R. Hoffman, manager of the Seattle Municipal Power Plant, and Robert Beck, Aberdeen, Wash., directors.

Formation of APPA follows closely upon the heels of a house committee's approval of an administration bill authorizing the Reconstruction Finance Corporation to lend up to $150,000,000 for purchase of segments of private utilities which must be sold to comply with the Holding Company Act "Death Sentence." This act also strictly regulates utility service companies, although scope of the law would not bring the public ownership activities under regulation.

The organization's incorporation papers state that matters of National Defense and pertaining to relations between municipal operations and the federal government will get its first attention. Significantly enough, this pledge follows closely the recent battle between REA and public power Congressmen with OPM over the question of copper allocation for building rural lines during the war, and recent deals negotiated by Federal power agencies looking to construction of two high-capacity public transmission lines in New York and Arkansas.

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REA Wants Plea Denied Or Approved as Whole

An attorney for the Rural Electrification Administration told the Kentucky Public Service Commission that REA had rather be denied the right to build a 15,000-kw. generating plant at Ford than to be forced to build the plant without 380 miles of REA-owned transmission line to distribute it.

"I take it you want your application denied as a whole or approved as a whole?" Commissioner J. J. Greenleaf asked Ernest L. Rushmer, Washington attorney. "That is so," Mr. Rushmer replied. The two-day hearing on the $4,000,000 project ended when Chairman John Kirtley adjourned it until January 20. Kentucky Utilities Co., which has intervened in opposition to the REA project, is scheduled to begin proof on that date.

The generating plant and transmission system would be owned by a cooperative formed of the thirteen local REA co-operatives serving Kentucky in the area east of a line drawn south from Louisville.

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SEC and REA Moved Out of Washington

Two government agencies involving utilities are being transferred out of Washington as part of the Administration's decentralization program to make office and residential room in the nation's capital for the influx of wartime employees.

The Securities and Exchange Commission is to move to Philadelphia and the Rural Electrification Administration to St. Louis. Street addresses in the new communities have not been selected, but the transfers are to be made within the next two months. Both agencies will maintain small liaison offices in Washington but headquarters, including all executive and administrative personnel, are to be moved.

A dozen federal agencies were affected by the initial decentralization order, and more are to be transferred in the near future. More than 10,000 government employees are affected by the first order, but this is less than one-fourth the number of additional employees expected in Washington by next July and an even smaller fraction of the increase which has occurred since the defense program started in June, 1940.

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Plan Niagara River Weir

Representatives of the Canadian and United States governments and power executives met in Niagara Falls, Ont., recently to discuss plans for construction of a weir in the Niagara River to eliminate the danger of a power shortage in case of ice jams. Construction of the weir, a submerged breakwater-type obstruction, is expected to begin next Spring.

WHEN MIDNIGHT STRIKES—"Two on and two off" is the gate routine at Boston Edison's general service buildings, when armed employees sworn in as special police change guard during the night watch

Hartford Company Adopts Service Economy Theme

Enlargement of generating facilities accompanied by commercial service policies to aid customers in utilizing energy more efficiently — Gas-filled cable serves defense load

Although the Hartford Electric Light Co. is making a major contribution to the defense program by supplying energy to local industries vitally identified with the production of armament, machine tools, aircraft engines and other facilities, it is devoting no little effort to the important problem of aiding its customers generally to obtain more value for their electrical dollars. This objective is visualized as an economic one bearing directly upon the conservation of resources influential in the defense undertaking.

Free Advisory Service

Sound economics in the application of electricity in the commercial and residential fields help industries by releasing capacity on the utility system, besides contributing to bring about higher income to businesses. In the face of diversions of material from the non-defense market to armament manufacture, the commercial service division of the Hartford company aims to establish more complete and direct relations between the customer and the company, rendering free advisory service on rates, engineered lighting, planned cooking, power and heating.

The division is composed of fifteen customer representatives who are thoroughly trained in all branches of the company's service. The lighting bureau is headed by W. D. Gorman and the power bureau is under the direction of E. D. P. Gross. The latter includes cooking, ventilation, air conditioning, heating and miscellaneous power.

Under present conditions this emphasis upon service without charge or obligation appeals to a wide range of customers both within and without the scope of the defense program. In the lighting field any or all of the company's customers, whether in old, new or proposed buildings, are faced with problems of detail calling for engineered installations.

In a circular distributed among customers the company points out that engineered lighting means a study of fixture efficiency, locations and mounting height, proper wattage, adequacy of wiring, reflective efficiency of walls, floors and ceilings and harmonious architectural or decorative effect. In like manner, analyses of cooking requirements, power applications, power-factor correction (an important defense measure) and of wiring layout needs play a part in broader service to customers which in the long run insures more efficient use of utility capital and facilities.

Charts showing the increased energy now obtained for a given price and the tested benefits of modernized electric service were featured at the display pictured below. Due to increased lamp efficiency, reduction in lamp prices and lowered rates, the lumen-hours per dollar rose from 1,000 in 1920 to 1,820 in 1931 to 3,120 in 1941. The average energy consumption per residential customer, incidentally, has now reached an annual figure of 1,375 kw.-hr.

Here
A CARPENTER HAS TOOLS
A MECHANIC HAS TOOLS
A CHEMIST HAS TOOLS
THE HARTFORD ELECTRIC LIGHT COMPANY
THESE MEN ARE AT YOUR SERVICE...
At Your Service FREE

ADDED CUSTOMER SERVICE—More efficient and economical use of residential and commercial electric service, thereby contributing to defense power requirements, is goal of Hartford Electric broadened customer service program, typified by this display

Plant Construction Active

Work at the South Meadow station is being pushed by the Stone & Webster Engineering Corp. in connection with the addition of a new 45,000-kw. steam turbo-generator (G.E.), 450,000-lb.-per-hour B & W boiler and electrical improvements representing an estimated cost of $4,200,000, as previously referred to in ELECTRICAL WORLD. The steel frame for the boiler house extension is being erected and foundation work for the turbine unit is under way. Three 45,000-kva. three-phase bus tie transformers (G.E.) have been purchased to connect the 22- and 11-kv. buses at South Meadow.

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Copper Arrives for REA Lines in Washington

A carload of copper wire arrived in Lind, Wash., recently for the Big Bend Rural Electric Co-operative to be used in completing the 50-mile extension from Ralston through the Lind section to Beatrice in the western part of the county. Work of stringing the wire will begin immediately.

Construction of the line began the middle of last August and, with the exception of stringing the transmission wire, was completed before October 1. The work was then delayed by failure to receive the wire. In the meantime the 38 patrons to be served by the extension have had service wires run from transformers to their premises, buildings have been wired and appliances purchased.

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Tupelo Gives Customers $31,000 Defense Bonds

The city of Tupelo, Miss., the first to sell power at TVA rates, is giving $31,000 in national defense savings bonds and stamps to the customers of its municipal electric system, Tennessee Valley Authority has announced.

Mayor J. P. Nanney stated that savings bonds and stamps will be presented to 2,500 customers of the Tupelo municipal electric system next month as a

means of distributing the surplus earnings of the system among its customers and at the same time furthering our national defense effort.

This distribution will be made out of last year's revenues. During the fiscal year 1941 the system earned a net income of $35,000 and reduced its long-term debt by nearly $6,000 and repaid the remaining $10,000 of the city's original investment in plant. After the distribution of $31.000 worth of national defense savings bonds and stamps, the electric department will still have a cash balance of some $40,000.

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Electrical Industry Met Power Demands

The great increase in demand for industrial electric power, up 30 percent due to the defense effort, was successfully met in every section of the country except for a few weeks in the Southeast area, the Edison Electric Institute announces this week in its annual report.

Due to shortages of material, to other defense demands on manufacturers of turbines and to labor difficulties, generating capacity actually installed in 1941, fell 600,000 kw. behind the installation program it is stated. Further, the scarcity of basic raw materials and the high state of general employment indicates that further expansion of war production must come primarily by decreasing non-defense business and by longer hours of plant operation. In this way it was stated a further growth of energy output in kw. hr. may be gained without commensurate increase in requirements for new generating capacity.

Other salient points in the report are:

Peak loads increased 3,250,000 kw. during the year. Net addition to generating capacity amounted to 2,712,000 kw. or 538,000 kw. less than the increase in peak loads.

Installed capacity at the end of the year was 9,600,000 kw. in excess of the sum of individual peak loads compared with a margin of 10,150,000 kw. last year.

Scheduled for installation in 1942 are 3,665,000 kw. of generating capacity; for 1943, 2,750,000 kw.; for 1944, 1,400,000 kw.

Electric utility companies added 1,986,000 kw. in 1941 or 88 percent of the programs which they announced a year ago. After retirements the total central station generating capacity at the end of the year is 44,350,000 kw.

In 1941 the companies spent $600,000,000 on new construction, substantially the same as the budget reported earlier in the year.

Indianapolis Duplicates Its Boiler Installation

Company expects to save time, money and material by duplicating specifications of No. 9 boiler and keep capacity well ahead of demand

Additional boiler equipment, costing about $1,600,000, has recently been ordered for the Harding Street power plant of Indianapolis Power & Light, according to an announcement by H. T. Pritchard, president of the Indiana utility, who hailed this as another step in the company's long-range program to keep Indianapolis power supply ahead of the extraordinary demand resulting from national defense production in local industries.

This latest projected addition increases to approximately $7,100,000 the total expenditure ordered in less than two years to enlarge the Harding Street plant. The new boiler, to be furnished by the Combustion Engineering Corp., will be a duplicate of the one now being installed at Harding Street, which is said to be the largest in Indiana. It will be capable of delivering 400,000 lb. of steam per hour at 875 lb. pressure and 900 deg. F. total temperature, to operate new generating equipment.

Coal-pulverizing equipment, to be furnished by the Foster Wheeler Corp., for installation with the new boiler is expected to improve the efficiency of the entire plant and to provide fuel economy which is considered especially important under national defense conditions and the higher coal prices established by the national bituminous coal act.

Originally designed to have four generating units with the boilers necessary to run them at full capacity, the Harding Street plant will be completed upon the installation of No. 10 boiler—just ordered—and the 37,500-kw. No. 4 turbo-generator which was ordered last summer. Present schedules call for both these to be ready by the fall of 1943. Priorities have been requested of the OPM.

This final step in enlarging the Harding Street plant will increase its total rated capacity to 148,500 kw. and the total rated capacity of all generating plants on the entire electric system to 259,000 kw., it was stated.

By ordering the final boiler at this time and duplicating the specifications for the one now being completed the company plans to save time, money and material by fitting the new construction closely to previous expansion plans.

10,000 PLEDGE SUPPORT—Ten thousand G.E. shop workers at its Schenectady plant gather to approve resolution offered by president of the local CIO pledging uninterrupted support and best production efforts for those at the front

Power Shortages Foreseen in 1942-43

Serious power shortages in 1942 and 1943 are foreseen in important strategic defense areas, in the Southeast, the Southwest, the Pacific Coast and in parts of the middle West and "power pooling on a grand scale" will be resorted to, according to a statement released for publication this week by the Office of Emergency Management.

Power rationing is also predicted in those areas affected by the shortages to assist in supplying defense power. Blackouts of non-essential lighting, such as signs and show windows, are anticipated, as well as cooperation from citizens using electricity in the home.

It is expected that only heavy rains will prevent a recurrence of the power shortage in the Southeastern area. In Texas, Arkansas and Louisiana, where magnesium, aluminum and explosives plants are being built, a shortage in 1942 is considered "possible."

Shortages may develop in the Buffalo area, it was said, due to needs of electrochemical industries, and in St. Louis, where an electrolytic zinc plant and other defense plants are located. Despite large government dams in the Pacific Northwest, shortages may be felt there, it was stated.

Electrochemical and electrometallurgical processes are expected to require enormous quantities of power for production of aluminum, magnesium, high-grade alloy steel, copper, zinc and oxygen reduction processes.

Citing the large expansion in generating capacity contemplated by utility companies and governmental projects for 1942 and 1943, the report points out that turbines being built for the Navy and the merchant marine total approximately one-half of the present installed capacity of all the power plants in the country.

•

Three Factors for Distribution Design

Three major factors should be considered in designing a distribution system in time of war, availability of man-hours and materials, vulnerability to sabotage and vulnerability to aerial bombardment, F. M. Starr of General Electric told a local meeting of the A.A.E.E. at Tulsa last week.

As it is impossible to make substations and power lines completely invulnerable, systems should be designed with small standardized units rather than a few large units, he said, supplemented by portable and floating power plants.

Trends of considerable importance, Mr. Starr noted, have been (1) the increasing production of completely assembled factory-built substations and (2) the further standardization of designs and assemblies resulting, he said, in superior equipment at lower cost.

Referring to the two 10,000-kw. mobile steam-electric power plants built for the Navy (ELECTRICAL WORLD, November 8, 1941, page 9), Mr. Starr said his company is studying plans for a 50,000-kw. self-contained floating power plant.

•

All-Industry Banquet Held by Niagara Group

More than 400 attended the annual meeting and all-industry banquet of the Electric Association of the Niagara Frontier in Troop I Post headquarters in Buffalo, N. Y., recently. Twenty-two directors were elected for one-year terms. The following directors, representing electric light and power companies, were elected: T. W. Connette, W. S. Schmidt, M. E. Skinner and C. P. Yoder. Officers will be elected in January.

An elaborate entertainment program was presented following the business meeting under the direction of Mr. Connette. Raymond W. Mitchell, president of the association, and the board of directors were hosts at the party.

MEETINGS

Louisiana Engineering Society — Annual meeting, St. Charles Hotel, New Orleans, La., January 9-10. J. K. Mayer, secretary-treasurer, Suite 422, St. Charles Hotel, New Orleans, La.

Missouri Valley Electric Association—Power sales conference, Continental Hotel, Kansas City, Mo., January 15-16. L. D. Pettegrew, director 1527 Sharp Building, Lincoln, Neb.

Canadian Electrical Association — Annual winter conference, Mount Royal Hotel, Montreal, Que., January 19-20; Western members, joint meeting with Northwest Electric Light & Power Assn., Business Development Section and Commercial Section, Vancouver, B. C., March 4-6. B. C. Fairchild, secretary, 804 Tramways Buildings, Montreal.

American Institute of Electrical Engineers—Winter convention, New York, N. Y., January 26-30. H. H. Henline, national secretary, 29 West 39th St., New York, N. Y.

American Society of Heating and Ventilating Engineers—Annual meeting, Philadelphia, Pa., January 26-30. A. V. Hutchinson, secretary, 51 Madison Av., New York.

International Heating & Ventilating Exposition—Biennial exposition, Commercial Museum, Philadelphia, Pa., January 26-30.

Edison Electric Institute — Electrical equipment committee, William Penn Hotel, Pittsburgh, Pa., February 2-3; transmission and distribution committee, Hotel Cleveland, Cleveland, Ohio, February 9-11. Major H. S. Bennion, managing director, 420 Lexington Avenue, New York, N. Y.

American Institute of Mining and Metallurgical Engineers—Annual meeting, Institute headquarters, New York, February 9-12. A. H. Parsons, secretary, 29 West 39th Street, New York, N. Y.

National Electrical Manufacturers Association — Midwinter meeting, Palmer House, Chicago, Ill., February 16-20. W. J. Donald, managing director, 155 East 44th Street, New York, N. Y.

Utility Power Pool for Interim Power

Defense Plant Corporation has signed the contract offered by a group of private power companies in the Southwest which have agreed to pool generating facilities to supply 65,000 kw. of interim power for the government's big aluminum plant at Lake Catherine, Ark.

Arrangements with the private power pool were completed on the heels of DPC's deal with the Rural Electrification Administration for 32,000 kw. of interim energy, which an REA co-op will bring over a new transmission line from Grand River Dam (ELECTRICAL WORLD, December 20, page 4).

Exact routing of the lines to carry the energy to the aluminum plant now is before OPM's Power Branch for priority rating. The private companies have proposed that the Grand River energy be routed up to connect with their network near the Kansas-Oklahoma border, but indications are that OPM considers this too long a route to be practical, despite the fact it would take less copper than the REA direct line from the damsite.

Power for the private company pool (ELECTRICAL WORLD, November 1, page 78) will come from Kansas, Oklahoma, Arkansas, Texas and Louisiana. The aluminum plant is scheduled to begin operations June 1, with an ultimate capacity of 100,000,000 pounds of ingot annually. Present plans call for installation of an integral power plant some time late in 1942.

•

Second Attempt for Douglas Dam Funds

The Administration and all defense agencies joined in a second attempt this week to obtain Congressional approval of funds for immediate starting of construction of Douglas Dam hydro-electric project on the French Broad River. Congressman John Rankin, Mississippi, introduced a separate deficiency bill allocating $15,000,000 to be spent by next July 1.

Defense agencies repeatedly have declared that Douglas Dam power is vitally needed for aluminum and other war industries in the Tennessee Valley Authority area. The project, engineers estimate, can be completed by mid-1943, because equipment and crew now completing Cherokee Dam can be moved almost intact to the new project.

First effort to get funds for the job as part of the ten-billion-dollar war appropriation measure was defeated by the one-man stand of Senator McKellar, Tennessee (ELECTRICAL WORLD, December 20, page 5).

Output Falls Short of Specifications

The amount of electrical energy distributed by the electric light and power industry for the week ended Saturday, December 20, was 3,448,597,000 kw.-hr., according to the Edison Electric Institute, an increase of only 17,000,000 kw.-hr., compared to approximately 50,000,000 kw.-hr. in the corresponding week a year ago.

The peak for 1941 therefore is below what would have normally been expected as the 1941 weekly increments have been steadily diminishing from the 101,000,000 kw.-hr. figure of November 22.

In fact, if it had not been for substantial rainfall in the Southeast last week, aiding the TVA and Southern hydro companies, in all probability the figure would have been below the output for the week ended December 13.

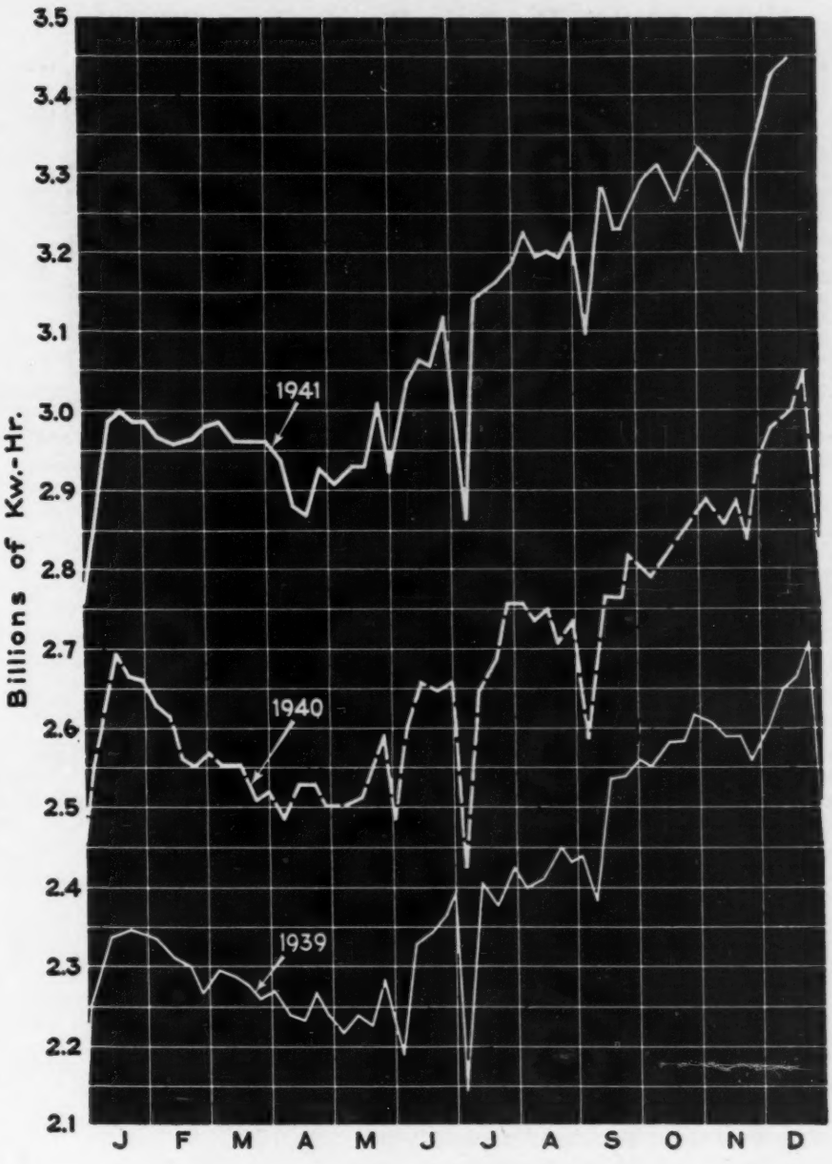
Weekly Output, Millions Kw.-Hr.

1941		1940		1939	
Dec. 20	3,448	Dec. 21	3,052	Dec. 23	2,712
Dec. 13	3,431	Dec. 14	3,004	Dec. 16	2,674
Dec. 6	3,369	Dec. 7	2,976	Dec. 9	2,654
Nov. 29	3,293	Nov. 30	2,932	Dec. 2	2,605
Nov. 22	3,205	Nov. 23	2,839	Nov. 25	2,561
Nov. 15	3,304	Nov. 16	2,890	Nov. 18	2,587
Nov. 8	3,325	Nov. 9	2,858	Nov. 11	2,589

Percent Change from Previous Year

	Week Ending		
	Dec. 20	Dec. 13	Dec. 6
New England	+17.1	+19.6	+18.2
Mid-Atlantic	+10.7	+13.3	+10.6
Central Industrial	+13.4	+16.0	+14.3
West Central	+12.8	+12.7	+11.9
Southern States	+16.4	+14.9	+13.8
Rocky Mountain	+12.9	+17.5	+18.7
Pacific Coast	*+7.9	*+6.8	*+9.8
Total United States	+13.0	+14.2	+13.2

*Percentage should be higher — data under revision.



Primary Loads Up 12.1%

An increase of 10.8 percent in primary and secondary loads carried by all systems of the Ontario Hydro-Electric Power Commission during November, as compared with the same month in 1940, is revealed in the monthly summary of loads. All systems showed a 12.1 percent increase where primary loads only were concerned.

•

Check Over Hetch Hetchy

Three members of a House subcommittee of the public lands committee spent several days in California last week investigating the Hetch Hetchy project and holding a hearing on the amendment of the Raker act to permit the city legally to sell power generated as a by-product of its water development. The investigation is in preparation for formal committee hearings scheduled for Washington on January 15. In the meantime the San Francisco supervisors have voted a fund of $10,000 to finance the cost of sending witnesses to the national capital.

•

Power Consumption Gain Reported in Memphis

Despite the OPM blackout of nonessential lighting in Memphis, Tenn., last month, the Light, Gas and Water Division showed a 3,700,000 increase in kilowatt-hour consumption over November, 1940. The electric consumption did decline, however, by 4,800,000 kw.-hr. in November, compared with October, Thomas H. Allen, commission president, announced.

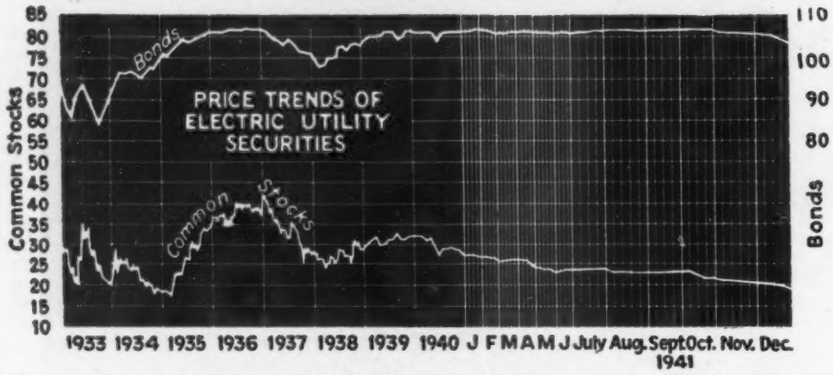
This slump cannot be attributed entirely to the blackout, Mr. Allen said. "There are a number of items that enter into the picture. For example, cotton came in early this year and started the gins working."

•

Plan Bay State Merger

Announcement has been made by the Federal Power Commission of the receipt of a joint application by Western Massachusetts Electric Co., Turners Falls Power & Electric Co., United Electric Light Co., Pittsfield Electric Co., all operating electric utilities in the State of Massachusetts, for approval of the merger and consolidation of the facilities of the four companies. As the surviving company, Western Massachusetts Electric Co. proposes to acquire all the assets and property of each of the other three.

Utility Stocks Decline; Bonds Drop Slightly


PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1933 1934 1935 1936 1937 1938 1939 1940 J F M A M J July Aug. Sept Oct. Nov. Dec.
1941

Downward trend in utility securities continued during the past week. "Electrical World" stock index dropped to 18.7 from 19.1 the previous week; last year, 26.7. Bonds dropped to 104.6 from 104.7 the previous week; last year, 106.3

New Repair Order Increases Quotas

OPM has issued a new repair and maintenance priority order available to thousands of manufacturing, distributing and public service concerns to help them obtain a continuous flow of materials to keep their plants in sound operating condition. A self-assigned A-10 rating is provided for those accepting the order's provisions.

Identified as Order P-100, the procedure replaces the repair and maintenance order P-22 which had been available to virtually the same classes of concerns. Perhaps most important change between P-100 from P-22 is that the new set-up authorizes purchases, withdrawals and inventories of repair, maintenance and operating materials up to 110 percent (in dollar value), in any current quarter, of the corresponding 1940 quarter. P-22 carried a 100 percent limitation.

Another change exempts all fuel supplies from the restrictive features covering purchases, use and inventory. Under P-100 the A-10 rating may be applied whether or not the material can be obtained without a rating. There are other changes, too, incorporating needs which have been demonstrated as necessary in the several months of operation of P-22.

•

Seeks Industrial Status

New England Public Service Co. has filed a proposed plan of compliance with Section 11 of the Public Utility Holding Company Act, providing for the divorcement of the utility subsidiaries from the industrial subsidiaries. Under the plan the present five utility companies would be reduced to three, each operating within its own state, except for one relatively small property in New York State. The three enlarged utility concerns would be divorced from New England Public Service.

•

Virginia Utility Files New Financing Plan

Virginia Public Service Co. has filed with the Securities and Exchange Commission a registration statement covering $22,800,000 of 3½ percent first mortgage bonds due in 1971; $5,700,000 of 2-to-3½ percent serial notes maturing semi-annually, June 1, 1944, to December 1, 1951; 70,000 shares of 5¼ percent cumulative preferred stock, $100 par value, and 628,333 shares of common stock without par value.

The new common stock will be issued in exchange for the present common stock and will be offered for sale through competitive bidding.

•

No Bids for Utility Issue

Deadline for bids on $42,000,000 of series D bonds, bearing 3⅜ percent interest, offered by the Public Service Co. of Indiana, Inc., passed at noon on December 16 without any purchasers for the securities. The utility had placed the issue on the market to refund $38,000,000 of outstanding bonds and pay for a proposed $4,000,000 expansion program. Company officials attributed the lack of bids to unsettled conditions in the bond market.

•

Approves Utility Sale

Federal Power Commission has announced its approval of the sale of all of the properties of the Ohio River Power Co. to the municipalities of Tell City and Cannelton, Ind., for the aggregate price of $600,000 in cash in accordance with the conditions of an application filed with the commission in November and as amended this month by Central U. S. Utilities Co., owner of all the securities and indebtedness of the Ohio River company.

•

Boston Tie Line to Be Studied

President James V. Toner of the Boston Edison Co. and President Edward Dana of the Boston Elevated Railway have announced that a joint study of the economics and capacity availability of an interconnection between the two systems has been agreed upon as a war measure. Several conferences have already been held to discuss the sale of surplus energy by the Elevated plants to Boston Edison. The railway's plants in South Boston and on Atlantic Avenue, Boston, are capable of generating more power than the transit system at present requires.

The situation is somewhat complicated by the difference in frequency, as the railway plants generate at 25 cycles and the Edison stations and their outside interconnections provide 60-cycle energy, but the analysis will review the possibilities of overcoming this handicap through suitable engineering procedure.

Some months ago a movement on behalf of the sale of the railway plants to the Edison company attained considerable headway through the support of various state authorities.

•

Files Refunding Plan

Alabama Power Co. has applied to the SEC for permission to refund its outstanding debt of $95,600,000, to reduce its stated common capital from $51,278,782 to $20,762,600, to eliminate $23,148,901 from its utility plant account and to increase its depreciation reserve by $2,217,000.

Utility Reports

	Net Income 1941	1940
*Alabama Power	$3,381,458	$3,096.825
*California Oregon Power	937,811	923,441
*Consumers Power	9,591,739	10,953,591
†Detroit Edison and subs.	12,609,200	10,446,719
*Georgia Power	5,373,498	4,134,119
*Gulf States Utilities	2,026,854	2,467,302
*Key West Electric	77,655	45,047
*Northwestern Electric	494,299	483,407
*Ohio Edison	4,019,362	4,086,780
†Public Service of N. J. and subs.	20,987,764	22,522,631
*Puget Sound Pwr. & Lt. and subs.	1,815,058	1,482,262
*Southern Colorado Power.	265,141	211,012
*Virginia Electric & Power.	4,013,910	4,087,367
*Western Public Service and subs.	182,564	168,203

*Twelve months ended October 31.
†Twelve months ended November 30.

OPERATING PRACTICES

Bushing Test Set Aids O.C.B. Checks

By E. J. MOMMO
Technologist, Testing Laboratory
Public Service Electric & Gas Co.,
Irvington, N. J.

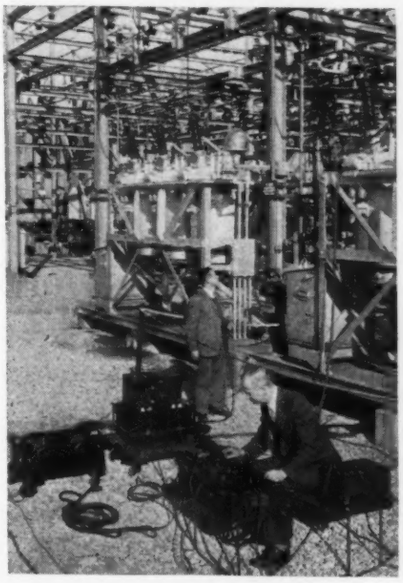
As an aid to replacement before breakdown can occur, periodic inspection of oil circuit breaker bushings is made at Public Service Electric & Gas Company, with a portable field bushing test set. The set provides a variable-voltage test source of up to 10,000 volts (for bushings of 26 kv. or higher) and makes use of a 70-cycle frequency supply to avoid stray electro-static and electromagnetic fields.

Five units make up the test set: Measuring unit, regulating unit, transformer unit, motor-generator unit and set of conducting leads. The motor-generator uses a 115-volt, 60-cycle self-starting synchronous motor. Voltage output of the generator —approximately 83 volts—is stepped up to 10,000 volts for test purposes by the transformer unit. With the regulating unit this voltage can be reduced as low as 1,250 volts; 7,600 volts is used by Public Service on 13-kv. bushings.

Both capacitance and power factor are read directly from dials on the measuring unit, a 90-deg. phase-shift switch being a convenient means for changing from one measurement to the other. Capacitance readings from 0 to 5,000 micro-microfarads may be made; readings of power-factor scale are direct for values to 0.1 (10 percent); for higher values to 0.7 readings are in cotangent values.

At the present time a test is run on each of the 6,000 oil circuit breaker bushings once a year, although plans are under way to make a test every six months. The surfaces of the bushing porcelain are cleaned and wiped with a towel soaked in carbon tetrachloride. Terminals are also cleaned and checked for tightness.

Two men make up the test crew; one man makes the measurements and records the values. The second hangs the connecting high-tension lead to the test specimen and manipulates the normally open safety switch which controls the supply voltage to the step-up transformer. Test leads are shielded. An additional safety precaution is the grounding of the top plate of the measuring unit. Should the ground connection to the top plate be broken the motor would automatically stop. In addition, there are safety gaps in the measuring unit and in the terminal box of the transformer unit to prevent the potential of the shield system from rising to a dangerous value in the event the dielectric under test should fail. The safety gap in the measuring unit is a neon-glow lamp which lights should a fault occur.



BUSHING test set facilitates field investigation of oil circuit breaker bushings

Test man in foreground makes measurements of dissipation factor (cotangent ϕ) and capacitance, while second test man connects test lead to bushing and controls supply of test voltage with safety switch in his hand.

Tests are made with the oil circuit breaker open and closed. Readings are taken of capacitance and dissipation factor in percent (cotan ϕ). In-phase components of leakage current values are quickly calculated for each bushing and bushings which have a higher value than 8 microamp. per kilowatt are further investigated. If this check confirms that the leakage is above the limit it is recommended for removal. Bushings which satisfactorily pass the test are marked with a paper label fastened with rubber cement to the bushing flange.

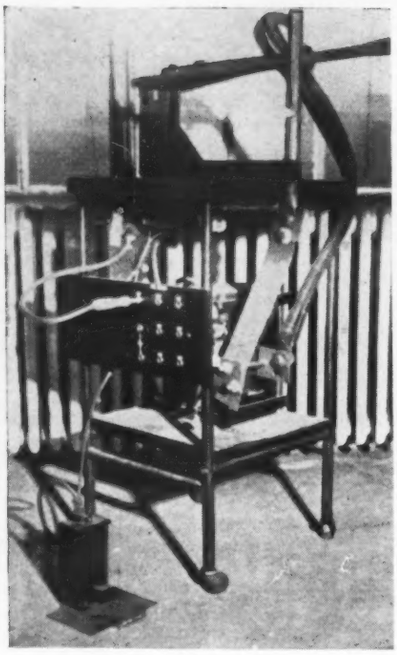
These tests are made with a Leeds & Northrup bushing test set; two sets are in use at Public Service at present.

•

Meter Shop Welder for Light Repairs

For light welding jobs around the meter laboratory meter men of the Central Illinois Public Service Company, Springfield, Ill., have built a spot welder out of spare parts which they report will satisfactorily weld metal stock up to $\frac{1}{8}$ in. thick.

Basic element of the welder is a transformer made by winding 160 turns of glass-insulated No. 6 magnet wire on the core of an old G.E.-type P, 25-cycle, potential transformer. Primary coil is tapped at



SPOT WELDER improvised from spare parts performs light welding duty in utility meter shop

100, 110, 120, 130, 140 and 150 turns to provide the necessary secondary current adjustment. With the transformer primary connected across 220 volts primary currents up to 50 amp. can be obtained, depending on the tap used.

Secondary of the transformer consists of one turn of $\frac{1}{4}$ x 3-in. copper busbar, potential is $2\frac{1}{2}$ volts. Terminals of the transformer secondary are brought out to "electrodes" made of 1-in. IPS tubular copper bus, one of which is firmly attached to the body of the welder, the other to the manually operated handle.

A high line telephone foot switch, equipped with heavier contacts, is used to operate the two-pole contactor arranged to open both sides of the supply circuit.

This welder has been successfully used for some time to weld light sheet metal hanging fixtures to time switch clocks.

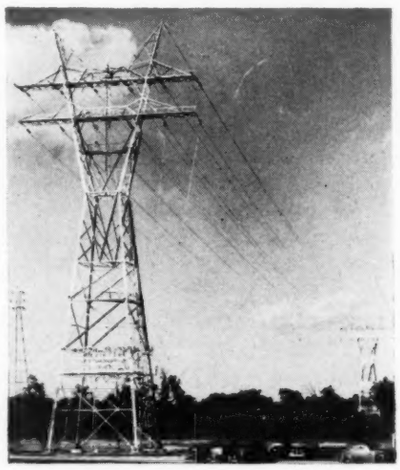
•

River Span Designed for Flexible Operation

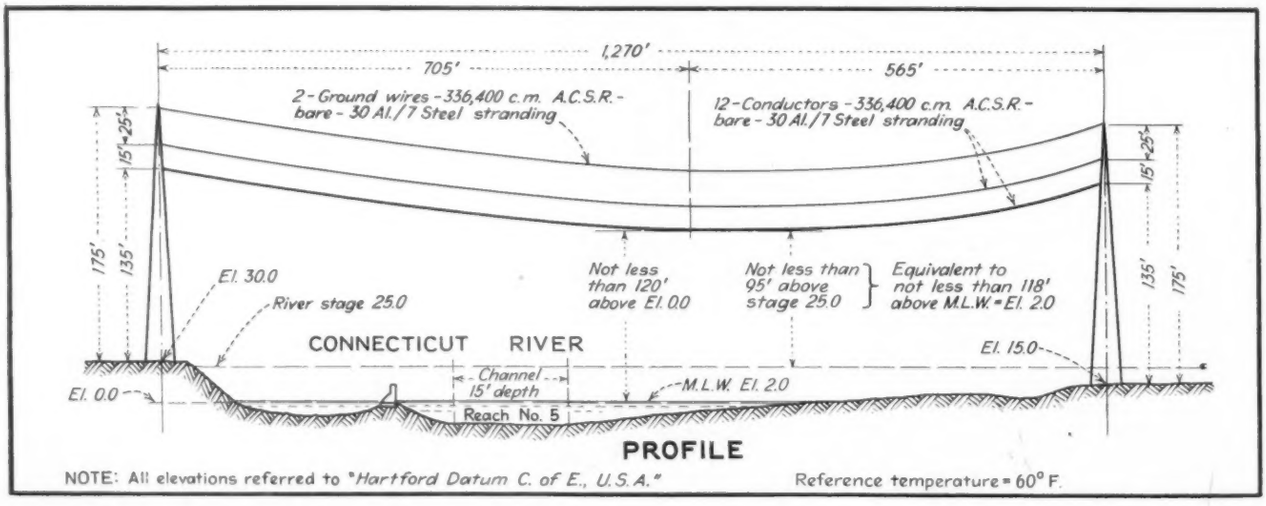
Expansion of the Hartford Electric Light Company's service recently required the construction of a 1,270-ft. transmission span across the Connecticut River to augment existing facilities supplied through submarine cables and to provide for four new circuits with spacing for ultimate operation at 110 kv. if necessary. The span utilizes two 175-ft. steel towers provided with two crossarms each for supporting the power circuits, with two ground wires terminating at strain insulators fastened to extension arms at the tower tops. The ground wires were insulated to enable their use as power conductors through jumper connections in case of failure of phase wires below, and the tower structures carry framing at a platform about 20 ft. above the ground to support potheads and Cadwallader sleeves in the transition from underground cable to overhead construction.

Initially these circuits are for 22-kv. operation, the phase conductors being spaced 15 ft. apart horizontally in each row of six, the ground wires being 47 ft. 6 in. apart and 25 ft. above the upper arm. The upper and lower arms are 15 ft. apart, and at this writing the two upper circuits have not been connected with their supplying cables. Each power conductor is a 336,400-cir.mil. ACSR bare stranded cable, the ground wires being of the same construction. Minimum clearance of the bottom pair of power circuits above mean low water is 118 ft. Tower legs are supported on concrete piers carried by concrete mats below, concrete or oak piling being used where necessary for the latter. The piers are set 35 ft. apart on centers in each direction on each side of the river and are from 14 ft. to 22 ft. deep according to local conditions, 4 ft. square at the top, the mats being 12 to 15 ft. square and from 4 to 9 ft. thick.

The tower legs are grounded on each side of the river. Parkway type cable is installed for the existing pow-



CLOSE-UP of west tower showing power circuits, diagonal risers from pothead and cable connections


1,270'
705'
565'
2 - Ground wires - 336,400 c.m. A.C.S.R. - bare - 30 Al./7 Steel stranding
12 - Conductors - 336,400 c.m. A.C.S.R. - bare - 30 Al./7 Steel stranding
175'
135'
15'
25'
El. 30.0
River stage 25.0
Not less than 120' above El. 0.0
Not less than 95' above stage 25.0
Equivalent to not less than 118' above M.L.W. = El. 2.0
CONNECTICUT RIVER
El. 15.0
El. 0.0
Channel 15' depth
M.L.W. El. 2.0
Reach No. 5
PROFILE
NOTE: All elevations referred to "Hartford Datum C. of E., U.S.A."
Reference temperature = 60° F.

ELEVATION of four-circuit span across Connecticut River

THEY'RE BOTH 15 KVA But I'd Rather Handle the SPIRAKORE!

LIGHTER WEIGHT AND SMALLER SIZE are advantages of the Spirakore transformer that were made possible by the ingenious Spirakore design and the use of cold-rolled, high-permeability, silicon core steel. For example, in the 15-kva 2400-volt rating, the Spirakore transformer weighs only 390 pounds. Compared with the 505 pounds of the superseded design, this is a weight reduction of 23 per cent.

Other improvements resulting from the Spirakore development include a simpler, stronger interior construction, lower exciting currents, and improved impulse and thermal characteristics. Together, they make Spirakore your best buy in distribution transformers. General Electric Company, Schenectady, N. Y.

Specify Spirakore transformers—designated Type HS. Available in many ratings up to 500 kva

GENERAL ELECTRIC

402-29-5100

er circuits after leaving the east river crossing tower.

The span is designed for ½ in. of radial ice thickness at 8 lb. wind pressure and zero Fah., the maximum conductor cable tension being 8,520 lb. Towers are of Blaw-Knox design and were designed for 90 percent total loading.

Span lighting is provided with two 500-watt Crouse-Hinds 300-mm. type FCB12 flashing beacons (30 per minute) in PS-40 Mogul pre-focused bases, and located 155 ft. 11 in. above ground. There are also two 500-watt projector type lamps (Crouse-Hinds) mounted about 154 ft. above ground and directing light along the catenary of the span, Mogul T-24 bipost bases being used. The usual obstruction markers (type A-21 clear traffic signal lights, Crouse-Hinds, 100 watts each) are provided for airplane use. Lighting is supplied by separate 115-volt circuits controlled by an astronomical time switch on each tower.

•

Reclosers Avoid Substation Investment

In expanding rural service the Nebraska Power Company started supplying a part of its rural 13.2-kv. system from a 2,500-kva. substation of another utility. In so doing its engineers have, in effect, converted the 13.2-kv. line which passes this substation into a mile long substation bus through the strategic placing of automatic pole-top reclosers.

As shown in the accompanying diagram, four three-phase feeders were established by installing four sets of three single-phase reclosers and they now supply the load formerly supplied by two three-phase feeders equipped with three-pole oil circuit breakers. In this way single-phase switching is secured on each of the four three-phase lines, preventing the loss of more than approximately one-twelfth of the load in the event of a single-phase-to-ground fault on any feeder, as compared with one-half the load heretofore.

The arrangement used was considerably less expensive than the construction of a conventional switching substation and experience has shown that customer outage has been materially reduced.

•

Low Cost Analysis for Distribution

By CHARLES E. BOULSON
Missouri Electric Power Company, Marshfield

To determine what steps would be necessary to achieve most economical distribution transformer loading and at the same time maintain satisfactory service voltages, a survey was conducted by the Missouri Electric Power Company. Detailed examination as to load and voltage conditions existing on the distribution systems was made at 28 locations, comprising a total of 500 transformer-secondary combinations.

The survey was based on the method of statistical analysis set up by C. E. Arvidson in "Distribution Planning," ELECTRICAL WORLD, October 7 to December 16, 1939. However, the load curves for lighting, refrigerator and range service as presented in the articles were believed to be too high. Accordingly, total peak loads for several locations as calculated on the basis of these curves were compared with peak fifteen-minute maximum winter substation demands. After allowing for transformer diversity and assuming an estimated over-all distribution power factor of 0.9 at the substation, it was found that an almost uniform multiplier of 0.8 would be necessary in applying the curves. Substation demands influenced by large power users were not employed in this comparison.

Calculations were made for transformer kva. capacity needed to carry the load at the respective locations. Adequate service voltage rather than thermal loading was considered the criterion in selection of transformer size, especially where ranges are involved. In the majority of cases transformer voltage drop required that a higher rating was necessary than that determined. Load factors averaged 18.4 for 3-kva., 18.8 for 5-kva., 23.7 for 7.5-kva., 24.4 for 10-kva., 33.4 for 15-kva. and 40.0 for 25-kva. transformers, not including those serving commercial or three-phase customers. Taking into consideration all classes of customers and service, average over-all loading for the transformers covered was found to be exactly 100 percent, although wide variations were present.

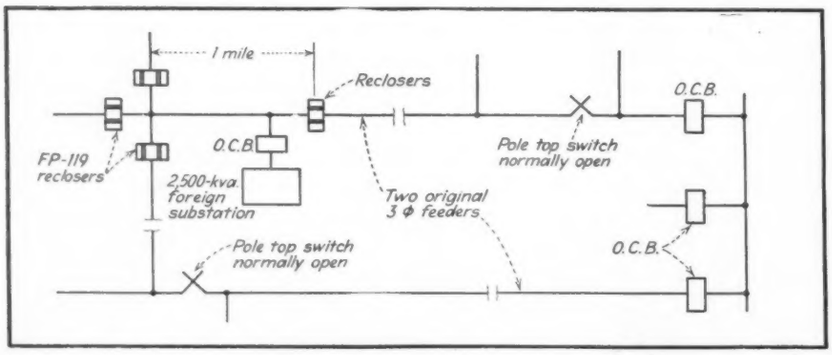
Cost of the survey totaled $2.70 per transformer, but it does not include the preparation of the distribution maps which were available. Since it is contemplated that the survey will be repeated every three years, the cost reduces to 90 cents per transformer per year. In return for the detailed information received this expenditure seems very reasonable.

•

Rubber Cable Cuts Street-Lighting Costs

Through its use of rubber-insulated cable for street-lighting service Staten Island Edison has realized an estimated 60 percent reduction in cost over lead-insulated cable in conduit. The 5,000-volt Simplex "Anhydrex" insulated cable is laid in an 18-in. trench and covered with a creosoted plank.

Approximately 2½ miles of this cable has been in service on one highway for about a year; another 2½-mile section has been in service for about two months. No cable trouble of any kind has been experienced. The highway is lighted by twin sodium-vapor lamps, spaced about 100 ft. apart.



STRATEGICALLY LOCATED pole-top reclosers limit loss of load due to single-phase-to-ground fault to small fraction of total

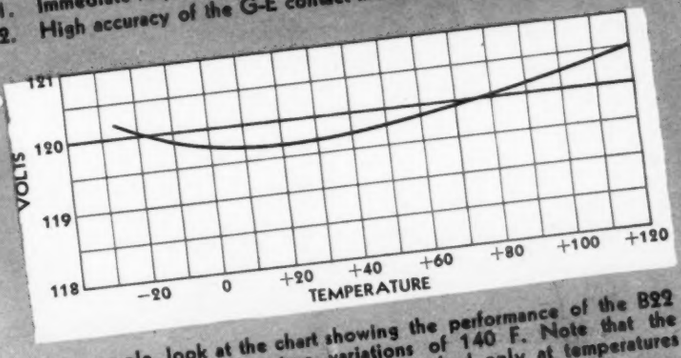
= 500 KVA

That's the EXTRA load-carrying capacity you get on a typical feeder with G-E INDUCTION REGULATORS*

WHY G-E INDUCTION REGULATORS Hold a Narrower Band Width

The closer regulation of the G-E induction regulator is based primarily on

1. Immediate response—without time delay—to voltage changes
2. High accuracy of the G-E contact-making voltmeter



For example, look at the chart showing the performance of the B22 voltmeter under temperature variations of 140 F. Note that the maximum error—one-half volt—is approached only at temperatures above 110 F.

Compare this curve with those for other contact-making voltmeters and you'll see one important reason why G-E regulation is better regulation.

YOU get a bonus of one-third or more *additional* capacity when you regulate your feeders with G-E induction voltage regulators. Recent tests show that they hold the effective band width to 2 volts or less, not 4 volts or more as provided by other types of regulation.

The narrower G-E band width permits you to add more load to your present feeders—500 kva uniformly distributed for a typical case—while maintaining the present peak-load voltage difference between the first and last transformer. Or, you can use the band-width advantage to increase feeder length. You may also elect to recover revenue lost because of feeder voltage drops.

These are operating benefits that enable G-E induction voltage regulators to pay you a large extra return on your investment in regulation. Ask your G-E representative to estimate the results you can obtain on your feeders. General Electric Co., Schenectady, N. Y.

★For Engineers Who Like to Do Their Own Figuring:
This typical example is based on a reduction of two volts in band width on a 3-phase, 225-amp, 4-kv feeder of 4/0 conductor; 53-inch equivalent spacing; length, 10,000 feet; load uniformly distributed; power-factor, 90%.

GENERAL ELECTRIC

404-19-5400

How "GF" (GAS FILLED) New Self-supervising Cable MADE GOOD On First Test in Big City

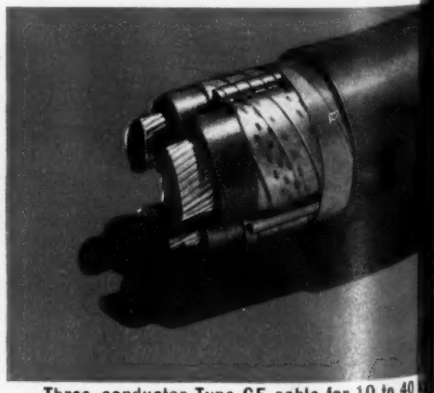
AT the bottom of an excavation in downtown Manhattan*, Type GF cable met and passed its first test with ease. A workman with an air drill accidentally gouged into both the conduit and the sheath of a line of this new cable. Not being a cable engineer, the workman didn't report the accident at once. He didn't realize that such a puncture, sooner or later, means "lights out" not only for equipment on the circuit but also for the cable itself.

Because the cable was of the new G-E gas-filled type, this incident had a happy ending. In less than half an hour after the cable was punctured, up drove the power-company service men—without having been summoned by the workman. Repairs took little time because the break was ***known in time,*** and more serious damage was avoided.

The service truck had been called by the cable itself. When the sheath was punctured, reduction of pressure, caused by loss of gas, operated a pressure relay. This in turn sounded an alarm in the control room at the generating station.

A total of more than 140,000 feet of Type GF cable is in service. Do you have our booklet describing this cable? The number is GEA-3652. Ask the nearest G-E office for a copy. General Electric Company, Schenectady, N. Y.

**System of the Consolidated Edison Co. of New York, Inc.*



Three-conductor Type GF cable for 10 to 40

GENERAL ELECTRIC

501-7-1200

INDUSTRIAL ENGINEERING

Large Motors Baked by Near Infra-Red

Drying of water-soaked motors is made easy with near infra-red energy and preheating of motor parts, coils, etc., is a matter of only a few minutes when radiant energy is used. Insulating varnish can be baked faster and better with the process because the baking is from the inside out, insuring that the interior will be as hard and as well protected from moisture as the exterior.

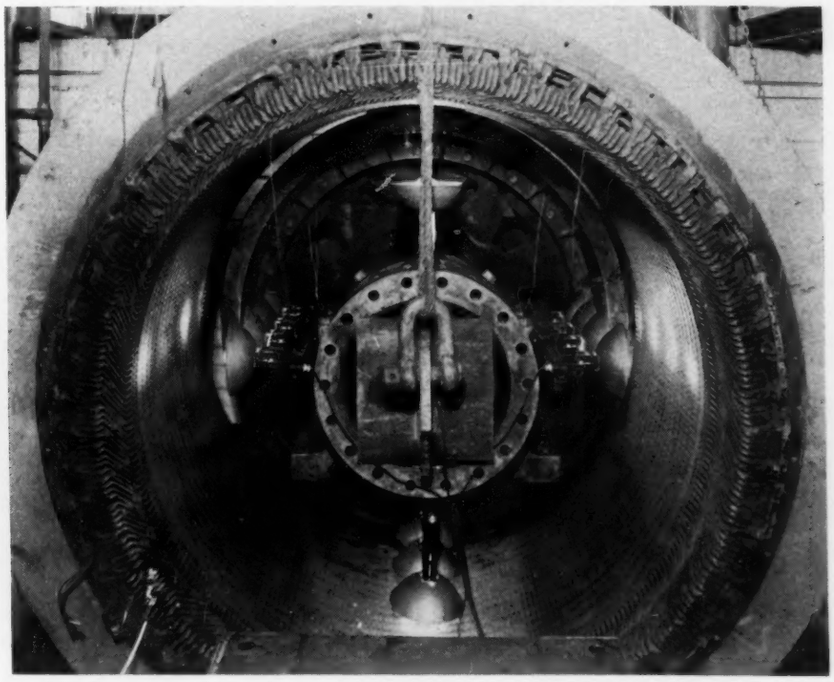
Baking time with radiant energy depends largely on the size or mass of the part being radiated, and also on the type of insulating material impregnation. Temperatures of 250 to 300 deg. F. may be obtained in a short time, these readings being taken, in the interior of the piece being baked, with a potentiometer at various intervals during baking period.

The process in many cases is a definite aid in affording speed to the national defense program, as is evidenced by the facts relating to the baking of a motor in the hold of the dredge *Hindes*, owned by the San Francisco Bridge Co.

This dredge was scheduled to sail for Honolulu to do extensive dredging in the harbor for the United States Government. A speedy overhauling job was required and the near infra-red process made it possible before the hurried departure. Equipment included 16 type IR reflectors and 250-watt lamps.

Another example relates to the repairing of a large motor on the dredge *Alamitos*, owned by Case-American Construction Company, Los Angeles. The dredge capsized and laid at the bottom of San Diego Bay for two weeks prior to rewinding and baking. For this job 250-watt lamps and the same type reflectors were used as in the *Hindes* job.

Both of the above jobs were completed by the Quality Electric Company of Los Angeles, using near infra-red equipment of the Fostoria Pressed Steel Corporation.



INFRA-RED EQUIPMENT is suspended to dry out and bake the insulating varnish on a 2,500-hp., 360-r.p.m., 2,300-volt, slip-ring motor on the dredge *Hindes*

•

Convert 25-Cycle Steel Furnaces to 60

By L. V. BLACK
Superintendent Electrical Department, Bethlehem Plant, Bethlehem Steel Company

Confronted with the need for additional power to take care of rapidly expanding steel-making facilities, Bethlehem Steel Company is converting its electric arc furnaces from 25-cycle to 60-cycle operation at its Bethlehem, Pa., plant. With the company's own power generating equipment working at full capacity, and only 60-cycle power available from outside sources, this was found the quickest method to avert an impending power shortage. At least a year would be required to obtain and install the equipment needed for converting 60-cycle power to the lower frequency, whereas a change-over of the furnaces is planned for completion this month, releasing this block of 25-cycle power used for electric steel making for other purposes.

In order to take care of the new load the Pennsylvania Power & Light Company is building an 8-mile, double-circuit, 66,000-volt, three-phase, 60-cycle power line, a 25,000-kva.,

66,000/6,900-volt transformer station and a 1-mile double-circuit, 6,900-volt line to the furnace building. This latter section involves the acquisition of ground rights and right-of-way across two railroads, one canal and the Lehigh River.

Bethlehem's own firm generating capacity is 38,000 kw., furnished by seven gas-engine driven generators, producing 22,000 kw., 25-cycle; a 15,000-kva. turbo-generator with an average output of 14,000 kw., 25-cycle, and a 2,000-kw. d.c. generator, used only occasionally. Under present-day operations plant loads are scheduled so as not to exceed 70,000 kw., or roughly twice Bethlehem's generating capacity; anticipated loads for 1942 are 90,000 kw. Even with the new 25,000-kva., 60-cycle line additional power will be required for future use in connection with additional facilities now planned. This will be taken care of by the installation of a 20,000-kw. frequency changer, tying in with the local utilities' interconnected 60-cycle source.

At present the steel company operates a 6-ton, a 25-ton and two 50-ton electric arc furnaces at the Bethlehem plant. These are used exclusively in the production of alloy steels. The 6-ton furnace will not be affected by the change, but will be maintained on the 25-cycle circuit.

Swings and Flicker

In order to prevent excessive swings and flicker in the power company's 60-cycle system, due to the wide variations in the load occurring during the melting-down period of the arc furnaces, it will be necessary to install a 20-000-kva. synchronous condenser near the furnaces.

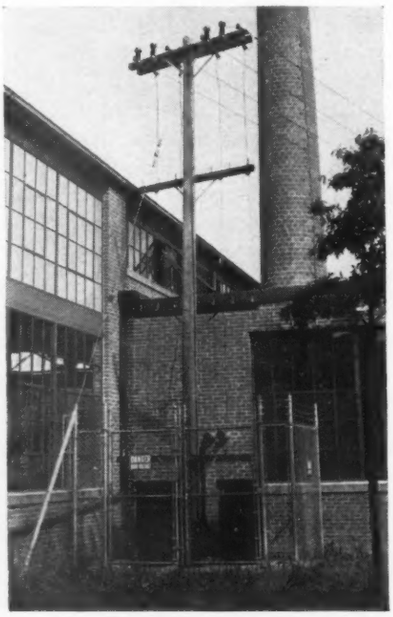
Changes required to convert the arc furnaces from 25 cycle to 60 cycle are minor ones. The system's external reactors, equipped with tap-changing switches for varying the reactance, 5, 10, 15 and 20 percent so as better to regulate and control high fluctuations in load on the 25 cycle system, will not be needed or used on the 60-cycle system. A few 25-cycle meters and relays will be replaced or rebuilt for the higher frequency. The present circuit breakers and the transformers used with the 25-cycle system can be used on 60 cycles without any alterations, but with slightly reduced ratings on the full capacity taps.

To keep the transformer temperature within the safe operating range it will be necessary to cut the power input to the furnaces about 20 percent during the melting-down period. This represents about one-third of the time required for completing a furnace heat. Theoretically it will result in a slight reduction in the output of the furnaces, but this can only be determined after the furnaces have been placed in regular operation on the 60-cycle system.

•

Saving Material in Factory Substation

In furnishing energy to an extension of a New England industrial plant engaged in manufacturing material widely used in the defense program a simple step-down transformer installation containing two 100-kva. single-phase units supplied from a two-phase overhead line was set up on a basis to conserve material as follows:



SINGLE-POLE primary service and ground mat conserve space in supplying energy to defense-product plant

The primary leads were carried from the street circuit of the utility across a service building in a single span terminating on a 30-ft. pole placed inside a 7x12-ft. fenced inclosure 8 ft. high at a corner of the buildings otherwise unused. The incoming phase wires ended on strain insulators supported on a crossarm also carrying lightning arresters connected to an inclosed ground wire running down the pole to earth. Taps taken from the incoming wires were run to insulators on a second arm at the pole top and dropped vertically to a lower crossarm, from which leads were run directly to the primary bushings of the transformers.

The secondary leads were then carried into the shop building through conduit and wall bushings to a distributing switchboard controlling the interior distribution. The simplicity and compactness of the layout reduced the amount of material required to the minimum, and by locating the transformers inside the fencing and on a ground mat no steel or wooden frame structural members were necessary, and the secondary copper was also minimized because of the access of the transformers to the interior switchboard.

•

Easy Way to Improve Power Factor

By G. L. HODDY

General Electric Company, Cleveland, Ohio

Opening a switch boosts power factor over 25 percent. It can happen. Power factor in a certain industrial plant was 45 percent when we were called in to make a survey. Among other things, a synchronous motor was found driving a line shaft to which no machinery was connected. The plant electrician explained that he had been instructed, about six years previously, to keep that motor running in order to improve power factor.

Further investigation revealed that the motor was operating with no excitation on the field. On questioning the electrician again, he stated that the exciter had become short-circuited about five years earlier, so it had been removed from service. Moreover, he added, the synchronous motor seemed to operate quite satisfactorily without excitation, so he felt that the exciter was just a frill and really wasn't very essential.

The motor was taken off the line and power factor immediately jumped up to 75 percent. Additional improvements were then made with shunt capacitors to raise power factor to 95 percent. The old synchronous motor, which rendered five years of faithful service as an inductive reactor, was scrapped.

NEW ENGINEERING IDEAS

A Photometer for Fluorescent Fixtures

By H. W. WRIGLEY
Development Engineer, Westinghouse Lighting Division, Cleveland, Ohio

In order to make accurate photometric tests of fluorescent fixtures it is necessary to satisfy three conditions:

1. Photometer must be large enough to accommodate fixtures 5 ft. long.
2. Fixtures must rotate about their own centers to any combination of angles desired.
3. Test distance must be variable.

The first of these conditions is one that in general could not be fulfilled with available equipment. There were no photometers available that would hold a fixture 5 ft. long. Accordingly, the photometer shown in the accompanying illustration was constructed to fulfill this purpose.

To obtain the necessary test distances the luminaires had to be mounted facing along the room instead of in the conventional position. As a provision for future requirements the photometer was made large enough to hold fixtures up to 10 ft. long or 2 ft. in diameter. Two axes of rotation were provided to permit adjustment to any angle. One was a horizontal axis through the mounting shaft and the other was a vertical axis through the center of the base about which the entire upright assembly revolves. Suitable scales are provided for accurate adjustment of the rotation about each axis. In operation the fixture is adjusted so that its light center is at the junction of the two axes of rotation, at which point the test distance will remain the same for all angular settings.

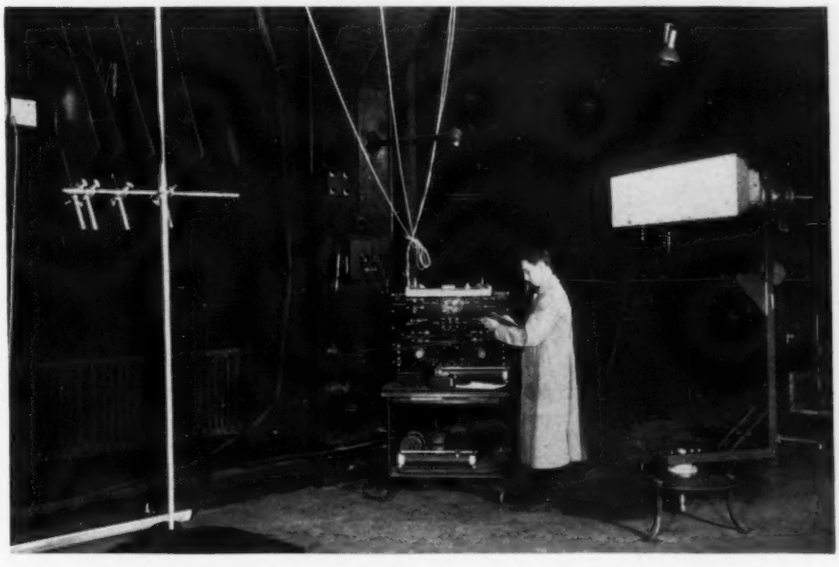
A barrier-layer type photocell is used as the measuring apparatus in conjunction with this photometer. Its current output is measured by a microammeter or galvanometer to indicate the candle-power directed toward it from the reflector. This photocell is suitably screened so that no extraneous light will influence the readings.

Although no new photometric principles are involved, there is a temperature effect which must be considered throughout the test. The light output of any fluorescent lamp depends upon the temperature of the lamp surface. The large surface area of these lamps makes this surface temperature dependent upon the air currents around the lamps.

Positioning Fixtures

In this photometer the reflectors are mounted with their open sides in a vertical plane. In this position it is readily apparent that the air currents about the lamps are greater than when the reflector is mounted in its normal position with the opening horizontal and facing downward. This means that the light output of the lamps during the tests is not the same as normally obtained. A correction factor must be applied to the measurements to compensate for this difference and the correct factor must be determined for every test. To facilitate obtaining this correction factor the photometer was constructed with a hinged upright member so that the fixtures being tested can be swung down into its normal operating position, permitting a direct measurement of the change in light output between the normal and test position.

The provision for obtaining the temperature correction factor also provides an ideal set-up for making temperature studies of lamp and reflector combinations and of fixtures mounted in odd positions.

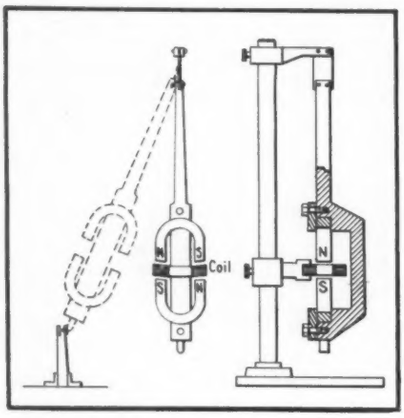


PHOTOMETER designed for fluorescent fixtures

Low Frequency Remote Control

By PAUL J. LAZARD
Dubera Corporation, New York, N. Y.

Developed in France for central control of street lighting in peacetime as well as for emergency black-out, a different method of signaling and control imposed on power distribution systems and without using pilot wires has come to the United States. Usual practice here is to use currents of frequencies higher than the commercial standard for such work. This method uses much lower frequencies, of the order of two to twenty cycles per second.



PENDULUM period fixes receiver frequency for specific control devices

The transmitter utilizes a storage battery or other low-voltage supply of direct current. It sends out alternating current mechanically inverted from this supply to one or more desired frequencies, depending on the number of control functions incorporated in it. The receivers, one or many, are selectively responsive to the one or more different frequencies of the function or functions incorporated in them.

In the transmitter the inversion device for each frequency consists of a clockwork with an escapement designed for the particular frequency, which through relays actuates a d.p. d.t. contactor across the d.c. supply, thus putting out an alternating current of rectangular wave shape.

As applied in France the frequency responsive assembly, one or more of which, according to number of functions, might be included in any receiver, consisted of a balance wheel and torsion spring like that used in a watch or clock escapement. In the American version a pendulum replaces the balance wheel and spring. As shown in the drawing the weight of the pendulum consists of two permanent magnets placed vertically jaw to jaw and an inch or so apart. Between the magnet jaws is a stationary coil energized by current from the transmitter. If the current is of a frequency corresponding to its natural period the pendulum begins to move, its swing gaining amplitude until a point on the pendulum closes a contact at the side, so initiating the desired operation. An appreciable time, depending on the current value in the coil and up to perhaps thirty seconds, is required for the pendulum swing to build up to make the contact. Thus the response of this mechanically tuned receiver is not instantaneous, as would be the case in an electrically tuned one. However, the lag in response is not a disability in the service for which the method is intended —turning street and other lights on and off, operating alarms and other signals and working other controls.

Although by the use of proper insulating means the method may be used on ungrounded systems, it was originally devised for systems with grounded neutrals. In application to the Paris direct-current system the connection of transmitters and receivers was between neutral and ground. The neutral had solid grounds at five substations and in the course of years had accumulated no one knows how many others under the streets. Yet with all these parallels the control method, employing a potential of three to five volts, worked satisfactorily. On alternating-current systems the connection may be the same as is used on direct current or may be between neutral and a live wire; choke coils that allow only the low-frequency currents to pass prevent flow of line current through the control apparatus.

The simplicity and apparent low cost of this method would seem to make it of considerable interest to American engineers, now confronted with problems of black-out and other control in connection with preparations for national defense.

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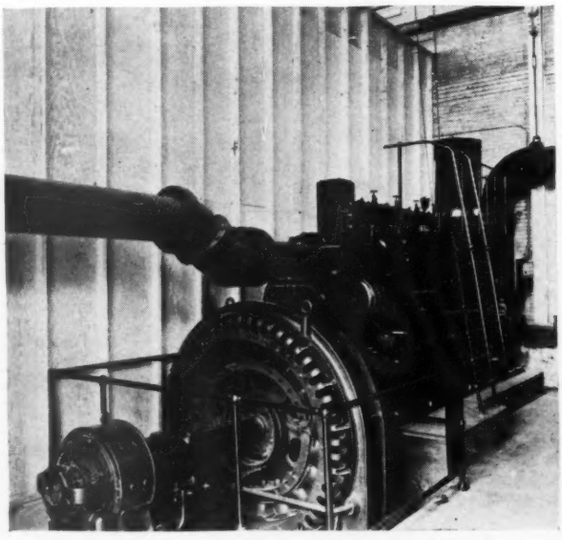
Erecting Unit in Dust-Proof Quarters

In connection with the installation of a 1,050-hp. Fairbanks Morse Diesel-generating unit at the plant of the Ipswich (Mass.) municipal lighting department it was necessary to reconstruct the foundations, as the new machine is to cover space formerly belonging to a smaller engine-generating set. The job involves considerable air drilling of the foundations, and to keep the concrete dust out of the rest of the plant the building contractor, Cashman Brothers, Newburyport, Mass., with the chief engineer of the station, Earle Hardy, erected a $\frac{1}{8}$-in. thick plywood compartment around the site of the unit. This was carried 21 ft. above the floor and is 15 ft. wide, and it discharges at the inner end into a 4 x 2 x 34-ft. plywood duct carried through a pump room in the station to a wall outlet, where a 28-in. fan driven by a $\frac{3}{4}$-hp. motor exhausts the dust outside the building. In the illustration one wall of the plywood compartment appears behind a 500-hp. unit, and the compartment is so tightly built and the fan equipment so effective that little trace of concrete dust is visible either on machinery or at the switchboard panels but a short distance from where the construction is being handled.



PLYWOOD-LINED COMPARTMENT protects adjacent generating and auxiliary equipment from cement dust during reconstruction of foundations

TACK HERE
G-E VARNISHED TUBINGS
Size numbers follow the B. & S. system of gauging bare wires. No. 0 tubing being designed to fit over No. 0 bare wire and so on throughout the scale. If tubing is to be used over a covered wire, allowance must be made for the thickness of such covering.
Standard colors: Black and yellow, all sizes.
Sizes No. 20 to 12 incl. available in colors: black, yellow, red, green, brown.
Standard length: 42 inches
Standard package: One coil
Hang this folder in a handy spot for ready reference
SATURATED "ALL THE WAY THROUGH"
GENERAL ELECTRIC CO. BRIDGEPORT, CONN.
GENERAL ELECTRIC
VARNISHED TUBINGS

SATURATED *"All the way through"*

G-E Varnished Tubings have an exceptionally high factor of flexibility and dielectric strength combined with extremely low moisture absorption. Through a special process, they are saturated with high-grade Insulating Varnishes—"all the way through."

G-E Varnished Tubings are part of the complete line of G-E Insulating Materials, a line that has proven outstanding through years of exhaustive tests with all kinds of electrical equipment. As one of the largest manufacturers of electrical equipment in the world, we recommend these materials to you. Every item does an excellent job for us. They will do the same for you.

The new sample packet illustrated above contains six colored samples of G-E Varnished Tubings with descriptions and a complete listing of available sizes.

SEND COUPON FOR SAMPLES

Section M-19B, Appliance & Merchandise Department,
General Electric Company, Bridgeport, Connecticut.
Sirs: Please send sample packet of G-E Varnished Tubings.

Name .....

Address .....

City ..... State .....

GENERAL ELECTRIC

LOAD BUILDING

Indirect Fluorescent for Drafting Room

One of the first applications of indirect fluorescent lighting to drafting rooms in the Middle West was made recently when several floors of the United Light Building at Davenport, Iowa, were remodeled for use by the United Light & Power Service Company. Results of experimentation with both direct and indirect fluorescent luminaires, which led to the installation and experience accumulated subsequently, point to several interesting conclusions.

The drafting room, which was to be lighted to a minimum intensity of 40 ft.-candles, is ell-shaped. It has a 10-ft. ceiling and a floor area of 2,980 sq.ft. Bays are approximately 18 ft. square, with four outlets per bay spaced 9 ft. in each direction.

At the outset fluorescent lighting of some type was indicated when calculations revealed that at the selected intensity heat from incandescent lamps would add several tons to the capacity required for the air-conditioning system, boosting first cost and operating expense.

Before any installation was made, however, four fixtures, both direct and semi-direct, were obtained from each of six manufacturers and installed temporarily. Each fixture was of the stem-mounting type equipped with four 40-watt white lamps. All were glass inclosed. Building construction was such that it was not feasible to use recessed units.

Four fixtures were installed in each bay and remained for several weeks. During that time the following observations were made:

1. Lighting intensities were uneven. Most of the units failed to produce the required 40-50 ft.-candles even under the unit.

2. First installed parallel to the lines of the drafting tables, the units were later rotated 90 deg. In this position illumination was improved, but glare was worse. In either case the tables located between units had a considerably lower intensity than those directly under the light.

3. Some of the draftsmen complained of headache due to glare.

4. Direct light in some locations made shadows along the edges of triangles and tee squares.

5. Draftsmen had a tendency to move tables around, apparently to get away from glare of lights in their line of vision to eliminate shadows.

Largely as a result of these observations the individual units were removed and replaced by continuous totally indirect troughs suspended 24 in. from the ceiling by stems at each outlet box and spaced laterally on 9-ft. centers. Each trough contained two parallel rows of 100-watt type T-17 white lamps. The entire installation consisted of 315 ft. of trough, containing 126 lamps totaling 12,600 watts. Lamp auxiliaries raised the wattage of the entire installation to 14,805, or 4.96 watts per square foot. Average illumination was 45 ft.-candles.

The ceiling area was painted a pure matt white. Since the light source was spread over a large area this worked out very satisfactorily. Brightness was not at all objectionable. Walls of the drafting room were painted light buff.

Cost of the indirect installation was by far the greatest of the three types of lighting considered. On a per square foot basis the installed cost of the indirect fluorescent lighting was approximately $0.82, estimated cost for direct fluorescent lighting $0.50, and incandescent $0.28.

One of the major problems with the indirect installation since its installation has been maintenance. Dust and dirt and insects collect rapidly on the upturned trough. For proper maintenance it is estimated that the troughs should be cleaned every two or three weeks.

CONTINUOUS indirect fluorescent troughs on 9-ft. centers yield 45 glareless foot-candles on drafting tables with 4.96 watts per sq.ft. and at an approximate installed cost of $0.82 per sq.ft.

"HUNDRED PERCENT SAVING" in floor space is achieved by mounting this Fostoria, 116 kw. infra-red tunnel on roof joists above production line

Infra-Red Tunnel Mounted on Ceiling

By WILLIAM J. MISKELLA
President Fostoria Engineering Service, Cleveland, Ohio

A large-capacity paint baking tunnel, free from the usual supporting framework and suspended in two half sections from the roof joists, has been placed in operation at the John G. Virden Company in Cleveland, one of the large manufacturers of electrical fixtures. All design and engineering details covering this unusual infra-red installation were worked out in advance before samples were available for checking and testing. This was made possible by close collaboration between the Patterson Sargent Company, which developed the special one-coat synthetic white enamel to bake in six minutes, the Fostoria Pressed Steel Company, which furnished the equipment, and ourselves.

In this installation the top portions of the parts being painted are only 7 in. from the wooden joists, yet in operation these joists are barely warm and carry the entire load which is suspended at sixteen points on 1-in. shafts. Rope pulleys are used to roll on these shafts so that, for maintenance, the two half sections of the entire tunnel may be spread apart. There is 20 in. space between the walls of the tunnel when in normal operation, and this may be increased to 48 in. by simply rolling the pulleys. Flexible wiring simplifies this operation.

A feature of this installation is that it saves 100 percent floor space. In order to work out the conveyor arrangement, it was necessary to have the parts pass at right angles under the suspended tunnel and to have the assembly girls work directly underneath. The accompanying illustration shows how effectively this worked out. Again, there is no discomfort from the heat of the tunnel, since one may comfortably hold his hand on the exterior of what is the floor of the tunnel.

The over-all length is 25 ft. and the height 7 ft. 6 in. The width is 42 in. The exterior of the half sections has been covered with sheet metal to streamline for appearance, wide gaps having been left at the top and bottom of the side sections for vertical ventilation of the sockets and wiring channels. The interior is lined completely with Fostoria hexagon-face gold-plated adjustable-focus reflectors and wherever gaps occur gold-plated steel blanks are inserted.

Full capacity of the infra-red tunnel is 116 kw. Each half consists of four sections containing 58 Fostoria 10½-in. reflectors equipped with 250-watt carbon-filament drying lamps. There is a configuration of sixteen reflectors around the work. A total of 464 lamps may be used when the equipment is in full operation. Through a Square-D fuse panel on the wall below almost any group of lamps desired may be placed in service. Full capacity of the outfit is 216 60-in. fluorescent fixtures per hour, but at the start the outfit will be operated upon a production of 100 per hour. The switching provides economical handling of the lamps for 24-in., 36-in. and 48-in. fixtures and associated parts. When production is 100 per hour the conveyor speed is approximately 3 ft. per minute. When 200 per hour are run the conveyor speed will be doubled and the lamps connected will be increased correspondingly.

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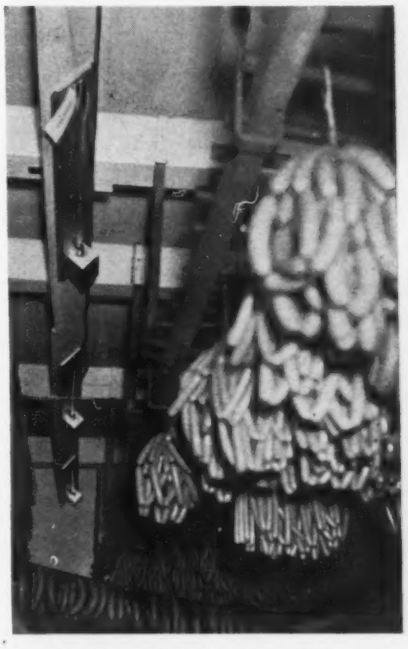
Sterilamps Stop Mold on Stored Sausage

Three of twelve 30-watt, 30-in. long "sterilamps" installed in the walk-in meat cooler of the Herziger Sausage Company, Sheboygan, Wis., retard formation of mold spores on stored sausage. These lamps are arranged in three rows of four each about their own length apart near the ceiling of the cooler. It is expected that their use will extend the allowable period for storage of sausage during summer months.



STERILAMP installation utilized to retard molding in large cooler installation

This is one of several installations in food industries in the Sheboygan district of Wisconsin Public Service Company.

NEW EQUIPMENT

Mercury Lamp

New tubular lamp of mercury arc, high-pressure type is 55 in. long. In effect it produces a like amount of light from

Mazda mercury lamp; 3,000 watts, rated 120,000 lumens. **General Electric Co.**, Nela Park, Cleveland, Ohio, and **Westinghouse Elec. & Mfg. Co.**, Bloomfield, N. J.

eight or nine 400-watt mercury tubes in separate fixtures. It is suggested for lighting large industrial areas where lofty mounting heights prevail, such as in foundries, steel mills, erecting shops, and the like.

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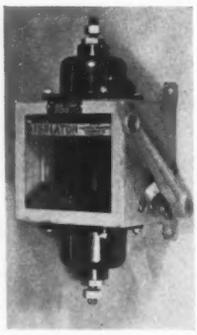
Disconnect

Telescoping isolator is a disconnect switch said to have the following features: (1) All current carrying parts are completely inclosed in insulation and terminals are designed for easy taping; (2) it requires no more space in the open position than when closed; (3) top and lower insulators can be used as bus supports.



Hook - stick - operated telescoping isolator; single pole, single throw, 400 amp, 5 kv. **Electrical Engineers Equipment Co.**, Melrose Park, Ill.

Solenoids

"Namco" stellite welded solenoids; ratings from 4 to 30 lb., push or pull, at 1-in. stroke, for commercial voltages and frequencies. **The National Acme Co.**, 170 East 131st St., Cleveland, Ohio.

New line of solenoids has welded stellite deposit in three surfaces of the plunger and one in the armature, effecting hardened surfaces at point of impact. The welding is said to eliminate plunger mushrooming and, in the plunger arms, to eliminate residual friction, and prevent wearing grooves in the laminations and misalignment with the guide plates.

•

Voltmeter Multipliers

Types "MFA" and "MFB" voltmeter multiplier; resistance ranges, 3.5 to 5.0 megohms and 1.0 to 3.0 megohms, respectively. **International Resistance Co.**, 401 North Broad St., Philadelphia, Pa.

Sealed precision voltmeter multiplier resistors are designed for performance under humid conditions. They consist of a number of wire-wound resistors, mounted and interconnected, and incased in a glazed ceramic tube. Monel ferrule terminals are hermetically sealed.

•

Connector

An all-clamp T-connector for tapping cable from tubing has flattened U-bolt for clamping flexible and extra-flexible cables. Oval-shank Everdur bolts are used to clamp the run conductor.

Type "NVT" T-connector; sizes, No. 8 to 2,000,000 cir.mil cable and ⅜-in. to 6-in. IPS tubing. **Burndy Engineering Co., Inc.**, 107 Eastern Blvd., New York, N. Y.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Oil Level Alarm

For protection against low oil level in power transformers, an alarm relay has a mercury switch which is positioned by an

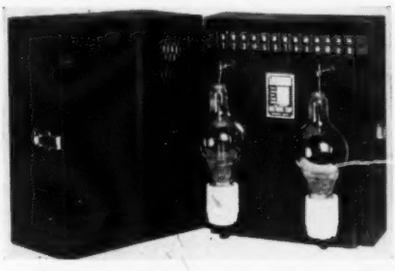
Model "T-25-F" low level alarm relay; single-pole, double-throw switch rated at 1 hp. **Fred H. Schaub Engineering Co.**, 325 W. Huron St., Chicago, Ill.

Alnico magnet, according to the operation of a float-operated piston. It can be used with audible and visual signals, also to interrupt pilot circuit on circuit breaker.

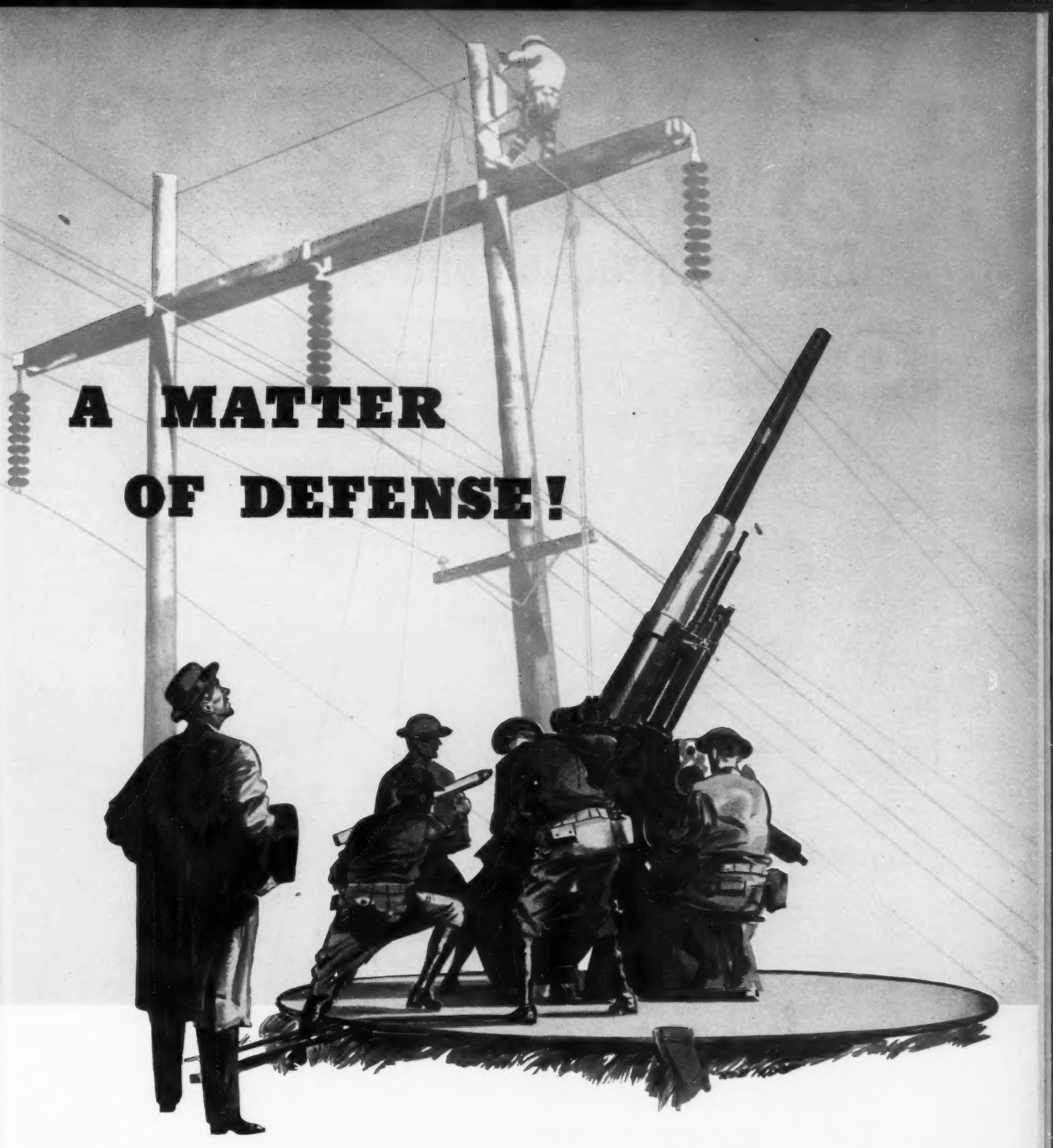
•

Rectifiers

In a line of full-wave industrial rectifiers, two single-plate tubes, one for each half cycle, are used in the units, which are housed, in turn, in inclosed cabinets designed for wall mounting. "Off" and "on" switch and an indicating light are mounted on cabinet door. Terminal strip is provided for connecting a.c. input and d.c. output lines.



Full-wave industrial rectifiers; eleven models, capacities ranging from 100 to 15,000 watts. **Weltronic Corporation**, 3090 E. Outer Drive, Detroit, Mich.



A MATTER OF DEFENSE!

Every mile of Pole Line that YOU build is a matter of defense effort. Every watt that flows through your conductors is a contributing factor toward the production of a bomber, a battleship or a field-piece.

These instruments of warfare cannot be produced without power—and power cannot be utilized without electrical transmission and distribution systems built to defy the naturally destructive elements of corrosion, electrical strain from lightning and mechanical strain from wind and sleet.

Whether it is a matter of defense or just good, plain, everyday customer service, it has to be RELIABLE. The engineer who specifies Hubbard Pole Line Hardware for his lines is giving his customers that quality which is an assurance of reliability.

ANG THE DEFENSE LOAD ON HUBBARD HARDWARE!"

HUBBARD AND COMPANY

PITTSBURGH, PENNSYLVANIA
CHICAGO, ILLINOIS
OAKLAND, CALIF.

HUBBARD

AMERICAN *Standard*
Line Construction and Service Bodies

De Luxe Line Construction Body

Over 60% of the operating companies using American Line Construction Bodies standardize on type D. P. L., pictured above. Pole setting, removing old wire, pulling in new wire, setting transformers are all part of a day's work for this versatile line construction body. Notice these advantages:

1. Low derrick tunnel,—makes loading of heavy derrick legs easier.

2. Offset side panels,—permit carrying the ladders and pike-poles on the outside of the body, promote quick handling of these tools.

3. 12-inch platform extension,—increases loading capacity for handling transformers and reels of wire.

4. Low floor height,—lightens and speeds the handling of heavy apparatus,—promotes safety.

5. Compartments for digging tools in each side of the superstructure are built with outside panels which stop 12 inches short of the ends of these compartments. This allows shovel blades to be stored within the end limits of the body where they can not inflict injury.

6. Rubber goods compartments immediately under roof on each side are 75 inches long,—accommodate standard 6-foot line hose.

Here's what American Standard Bodies mean to you: Lower initial cost; quicker replacement of parts from our stocks; longer life through balanced design and all-welded construction. More details in Booklet A-1. Write for your copy.

A C&B

THE *American* COACH & BODY CO.

WOODLAND AVE. AT E. 93rd, CLEVELAND, OHIO

MANUFACTURER OF STANDARD EQUIPMENT FOR PUBLIC UTILITIES

NEWS ABOUT PEOPLE

Dr. J. B. Whitehead Gets Edison Medal for 1941

Announcement has been made by the American Institute of Electrical Engineers of the award of the Edison Medal for 1941 to Dr. John B. Whitehead "for his contributions to the field of electrical engineering, his pioneering and development in the field of dielectric research, and his achievements in the advancement of engineering education."

Bachrach

Dr. Whitehead's chief professional interest over many years has been in the field of experimental research, and while he has been identified chiefly with education and research, he has also engaged actively in practice as consulting engineer. A graduate of Johns Hopkins University, Dr. Whitehead obtained his early experience with Westinghouse Electric & Manufacturing Co., Niagara Falls Power Co., U. S. Bureau of Standards and the Carnegie Institution of Washington.

He joined the teaching staff of Johns Hopkins in 1904, and when the school of engineering was established, in 1912, Dr. Whitehead bore the greater part of the burden of the planning and organization of the school and of the selection of the new faculty. He was appointed professor of electrical engineering in the new school, advanced to dean in 1919, director in 1938. He was consulting engineer to the Baltimore and Annapolis Short Line Railroad during its electrification and in the high-voltage insulation field he has had an extensive consulting practice. He was retained as consulting engineer by the city of Baltimore during its negotiations with the Pennsylvania Railroad Co.

Dr. Whitehead has been prominent in A.I.E.E. affairs, having served as its president 1933–34. Honors bestowed upon him include the Edward Longstreth Medal and the Elliott Cresson Gold Medal of the Franklin Institute, Triennial Prize of the Institute Elektrotechnique Montefiore Liege, Belgium, in 1922 and also in 1925, and the Medaille d'Honneur, University of Nancy, France, 1927. He has published numerous papers embodying the results of experimental studies and is the author of several books in the electrical engineering field.

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▶ LESTER H. KNAPP, chief industrial service engineer of the Blackstone Valley Gas & Electric Co., Pawtucket, R. I., has been appointed vice-president in charge of electric operations.

▶ JOHN M. EVANS, assistant manager, department of development, Shawinigan Water & Power Co., has been appointed chairman of the new Export Control Committee, according to an announcement by J. A. MacKinnon, Trade Minister. Mr. Evans' duties will be to administer control of Canada's export trade. In addition to Mr. Evans, the membership of the committee will include representatives of the Wartime Industries Control Board, the Foreign Exchange Control Board, Wartime Prices and Trade Board, External Affairs Department and Department of Trade and Commerce.

Herbert Metz Heads A.W. Executive Committee

Herbert Metz, general lamp and lighting sales manager of Graybar Electric Co., has been elected chairman of the executive committee of the National Adequate Wiring Bureau. Mr. Metz succeeds W. E. Sprackling, vice-president Anaconda Wire & Cable Co., who has guided the affairs of the bureau since this all-industry program was launched, nearly four years ago.

Mr. Metz has already made an outstanding contribution to the program, having been identified with the operation as chairman of the plan committee, since it was initiated. He brings to the chairmanship a wide background of experience in the electrical industry. Starting with the Western Electric Co. in Chicago, in 1915 he joined the advertising department in New York, and in 1923, when the supply and telephone departments were split, he was made advertising manager of the supply division. Upon the organization of Graybar Electric, in 1926, Mr. Metz became advertising manager and in 1928 sales promotion manager. Since 1939 he has held the position of general lamp and

SAFETY

INSURANCE

● When you get right down to it Miller Anode Electrician's Gloves are equivalent to a double insurance policy—one, on the safety of your highly trained, highly skilled men; two, against interruption of important operations, resulting from accidents.

In these times they both need a maximum of protection.

You can get that protection when you specify Miller Anode gloves, at no more cost than for others of equivalent specifications. Because they are made by Miller's patented Anode Process these gloves are more flexible, yet tougher, more resistant to tearing and snagging, longer lived, and of uniform thickness, which means thin spots and weaknesses have been eliminated. That's why they can withstand repeated electrical tests, even after water-soaking.

Order today from your local Miller jobber. He has all sizes in either straight-finger or "Curv-Flex" (curved finger) designs for Class A and Class B service.

MILLER RUBBER COMPANY, INC.
AKRON, OHIO

"Engineers in Rubber"

lighting sales manager. He was graduated from Penn State with a B. S. in electrical engineering.

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General Electric Names New Works Managers

Appointment of F. R. Kaimer as manager of the York (Pa.) works; F. H. Mains, as manager of the New Kensington (Pa.), works, and W. H. Tangeman as manager of the Ontario (Calif.), works, has been announced by W. Stewart Clark, manager of the Bridgeport works, manufacturing headquarters of the General Electric appliance and merchandising department.

Mr. Kaimer entered the Bridgeport Works laboratory in 1925 and was appointed superintendent of the York works in 1940. He has obtained several patents dealing with the design and manufacture of coated welding electrodes and ozone resistant insulated cable for neon signs.

Mr. Mains had been superintendent of the New Kensington works since 1926, having been associated with this plant even before it became a division of the General Electric. He started at New Kensington in 1912, becoming superintendent of the plant, which was then a part of the American Conduit Manufacturing Co.

Mr. Tangeman had been associated with the Ontario plant for many years before it was designated as the Ontario works of the General Electric Co. in 1933. His earlier years with the company were devoted principally to engineering work, but he gradually assumed increasing manufacturing responsibilities and in 1934 was made superintendent of the works.

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▶ T. W. Conrad has been appointed acting Omaha manager of the Graybar Electric Co. Mr. Conrad takes over his duties at Omaha after 32 years of service with the company. He started with the Western Electric Co. in 1909. He has been sales manager of the Tulsa office since 1928.

▶ Dr. Sanford A. Moss, General Electric engineer, and the Air Corps have been selected as recipients of the Collier Trophy, aviation's highest honor, in recognition of the invention and development of the turbo-supercharger which has made the United States four-engined bombers the greatest planes of their type in the world. The citation says that the trophy goes to Dr. Moss and the Air Corps for "outstanding success in high-altitude flying through the development of the turbo-supercharger." The Collier Trophy is awarded annually. Dr. Moss was connected with G.E. from 1903 to 1938, when he retired.

California Edison Names New District Managers

H. V. Busby, manager of Southern California Edison Co.'s Pomona district for the past five years, has been appointed assistant commercial manager of the company. Mr. Busby, who will assume his new duties in the company's general offices in Los Angeles on January 1, has been with the company for 23 years and has held a number of important commercial executive positions.

Other Southern California Edison personnel changes to become effective January 1 are: H. N. Kemp, assistant manager of the Ventura district, will go to Pomona as district manager; W. R. Teele, Beverly Hills district manager, will become special representative in the Inglewood and Redondo districts, succeeding W. G. Partridge, retired; C. M. Bliven, Huntington Park assistant district manager, will become Beverly Hills manager.

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▶ Frank J. Glossa, for the past four years executive assistant to Robert E. Dillon, vice-president in charge of engineering and production, Boston Edison Co., has been named head of a recently formed priorities division to facilitate the supply of materials and equipment for the defense service of that utility. Mr. Glossa joined the company in 1909. In 1937 he was admitted to the Massachusetts bar, and lately became a member of the federal bar at Boston and the bar of the United States Court of Claims, Washington, D. C.

▶ Joseph H. Gumz has been appointed commercial and industrial sales manager for the Pacific Gas & Electric Co. to succeed the late Harry Carroll. Mr. Gumz has been a member of the Pacific Coast Electrical Association for seventeen years and much of his activity with Pacific Gas & Electric has been in the gas sales department for commercial and industrial usage. A graduate of the University of Illinois, he entered the utility business in 1913 with Western United Gas & Electric Co. in Illinois, and later was with the Public Service Co. of Northern Illinois. He joined P.G.&E. in 1922. In his new position he will be manager of both gas and electric sales.

OBITUARY

▶ Guy F. Strafer, 65, manager of the Allis-Chalmers Manufacturing Co., Kansas City district office since 1923, died November 23 at St. Joseph's Hospital, Kansas City, after a brief illness. Mr. Strafer started with the Bullock Electric

Manufacturing Co., Norwood, Ohio, in 1897. Allis-Chalmers acquired the Bullock company in 1904. Mr. Strafer went to the Allis-Chalmers' Kansas City office in 1907, subsequently becoming its manager.

► WILLIAM T. CRAIG, assistant engineer for the United Illuminating Co., Bridgeport, Conn., died November 21 at the Bridgeport Hospital, following a long illness. Mr. Craig was associated with the power company for 20 years.

► ERNEST ROGERS, assistant to the president of the British Columbia Electric Railway Co., died in Vancouver recently, at the age of 68. Born in Scotland, he went to Canada in 1891 and joined B. C. Electric in 1903 as a clerk in the accounting department.

► CLIVE C. BELL, manager of Wisconsin Public Service Corp.'s rural development activities in the Wausau district, died on December 7, in a local hospital. Mr. Bell had been employed by the utility for more than 20 years.

► JOHN C. CARTER, office supervisor of the power and heating bureau of Buffalo Niagara Electric Corp., died on November 19 in Buffalo General Hospital, following a brief illness. He was 53 years old. Born in Buffalo in 1888, Mr. Carter, following graduation from technical high school and other technical institutions, entered the commercial department of the former Buffalo General Electric Co. in 1914. He had been connected with the commercial side of the electric business since that time. In 1928 he became assistant to the general sales manager of that department and later was made office supervisor of the power and heating bureau.

► OLIVER M. PERRY, manager of the hydro division of the Windsor (Ont.) Utilities Commission, died suddenly at his home in that city on October 24. He was 56 years old. Following graduation from Queen's University, Mr. Perry entered the shops of the Canadian Pacific Railway at Montreal. After he went to Toronto, he entered the employ of the Toronto Electric Light Co. in the engineering department, later joining Smith, Kerry and Chase on the Central Ontario system. When the Windsor Hydro-Electric system was started in 1913 he was made manager in charge of planning and construction of distribution within the city preparatory to receiving power through the Hydro, as well as its operation after it was put into service. Subsequently on the formation of the Windsor Utilities Commission he was made manager of the hydro division. Mr. Perry was widely known in Hydro circles throughout Ontario, taking an active part in the Association of Municipal Electrical Utilities, of which he was president in 1935.

"It all comes out in the wash"

Quality shows up quickly when put to the test. That's the reason for the tremendously increased use of Victor Insulators. Only through rigid control; modern manufacturing methods; time-tried experience, is it possible to achieve Victor quality. That's why we guarantee them: "The best you can obtain ANYWHERE at equal prices."

That, too, is why Victor Insulators are relied on to deliver dependable power to America's Arsenal of Democracy.

THE MARK OF A V GOOD INSULATOR

VICTOR INSULATORS INC.
VICTOR, NEW YORK

MANUFACTURING - MARKETS

Equipment Ordered for Boulder Dam

A turbine and governor for Boulder Dam's new giant generator have been ordered by Secretary of the Interior Harold L. Ickes from the Baldwin Locomotive Works at Eddystone, Pa., on its bid of $1,842,500. Contract covers one vertical-shaft 115,000 hp. hydraulic turbine and one oil-pressure, actuator-type governor with pumping equipment for regulating the speed of the turbine. An 82,500-kw. generator for this new unit was ordered recently from General Electric Co.

Another contract for Boulder Dam equipment, covering three transformers and one lightning arrester, went to Westinghouse Electric & Manufacturing Co. The contract covers a 230-kv. lightning arrester and three 55,000-kva. transformers on its bid prices of $7,182 and $325,120, respectively. The lightning arrester is for the switchyard extension of the Metropolitan Water District, a power lessee, and the power transformers are for generating units designated as N-7 and N-8 in the Nevada wing of the Boulder power plant.

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Manufacturers Make Sales Assignments

Sangamo Electric Co. has announced the appointment of A. B. Beach as its Cleveland (Ohio) district manager, with offices in the Rose Building. E. F. Heidorn has been named Pittsburgh, Pa., district manager, with offices at 1301 Clark Building, 717 Liberty Avenue.

Among the other manufacturing companies making appointments to their sales staffs are the following:

Buda Co. has appointed Ralph R. Hayes as eastern district sales manager with offices at the New York headquarters of the company, 253 West 64th Street.

Airtemp Division, Chrysler Corp., has appointed Edmund A. Orrell district manager in the Raleigh, N. C., territory.

Burlington Instrument Corp. has appointed Equipment Sales Division, 21 E. Van Buren St., Chicago, Ill., as sales representative in the Chicago territory.

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Westinghouse Adds to Porcelain Plant

To meet increased demands for a new type porcelain as a substitute for defense-needed plastics, aluminum and hard rubber, Westinghouse porcelain works at Derry, Pa., has started an expansion program that will step up manufacturing facilities 30 percent, E. H. Fritz, manager, has reported.

Two new buildings will add 25,500 sq.ft. of floor space to the Derry plant, permitting installation of new automatic presses and other equipment to triple production of Prestite porcelain for use as a substitute for phenolic plastics.

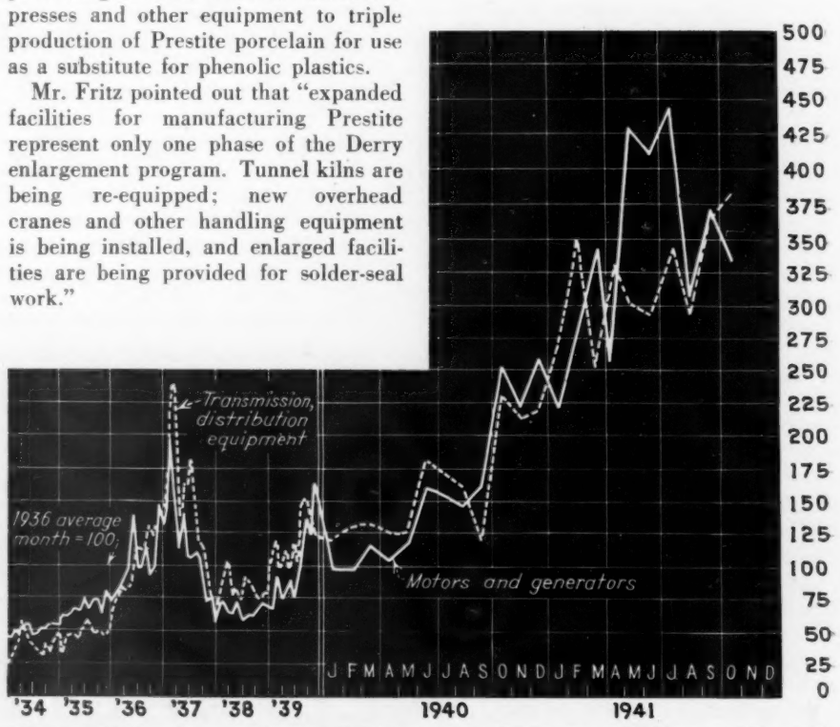
Mr. Fritz pointed out that "expanded facilities for manufacturing Prestite represent only one phase of the Derry enlargement program. Tunnel kilns are being re-equipped; new overhead cranes and other handling equipment is being installed, and enlarged facilities are being provided for solder-seal work."

New High Recorded for T. & D. Orders

Index of orders received for transmission and distribution equipment during the month of October again rose and recorded a new high, according to figures released by the National Electrical Manufacturers Association. The index of orders received for motors and generators moved downward, reversing the trend of September.

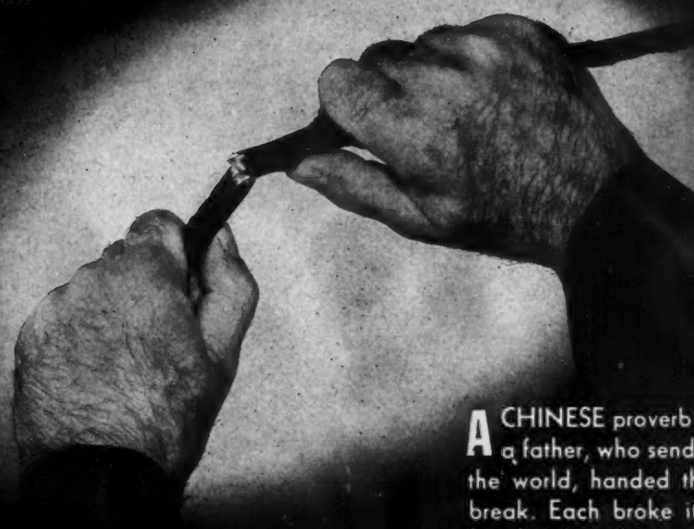
Index value of orders received in October for transmission and distribution equipment rose 24.3 points to 384.7 from the September index of 360.4, an increase of 6.7 percent.

Index value of orders for motors and generators declined 37.2 points to 332.8 from the revised September index of 370.0, a decline of 10.1 percent.


Transmission, distribution equipment
1936 average month = 100
Motors and generators
J F M A M J J A S O N D J F M A M J J A S O N D
'34 '35 '36 '37 '38 '39 1940 1941
500 475 450 425 400 375 350 325 300 275 250 225 200 175 150 125 100 75 50 25 0

NEMA INDEX, value of orders received for motors (large d.c. polyphase synchronous) and generators (engine, belt-driven); also for transmission and distribution equipment

THE THREE STICKS...



A CHINESE proverb tells of the wisdom of a father, who sending his three sons into the world, handed them a single stick to break. Each broke it with ease. He then handed them three small sticks but although the combined diameter of the three did not exceed the diameter of the large one, neither could snap them together. Moral: stick together boys.

And the same principle applies to a forging. The many tough fibers that make up its grain structure gives stronger, lighter hi-line hardware.

THE BREWER-TITCHENER CORPORATION
Cortland, New York

LITTLE LESSONS IN FORGING

The illustration shows both the male and female die, used in forging insulator caps. In forging these caps three steps are necessary; gathering the stock in the rolling impression, blanking out and forging to shape. These shapes are easily seen on the illustration of the dies. All three steps are accomplished in one heating.

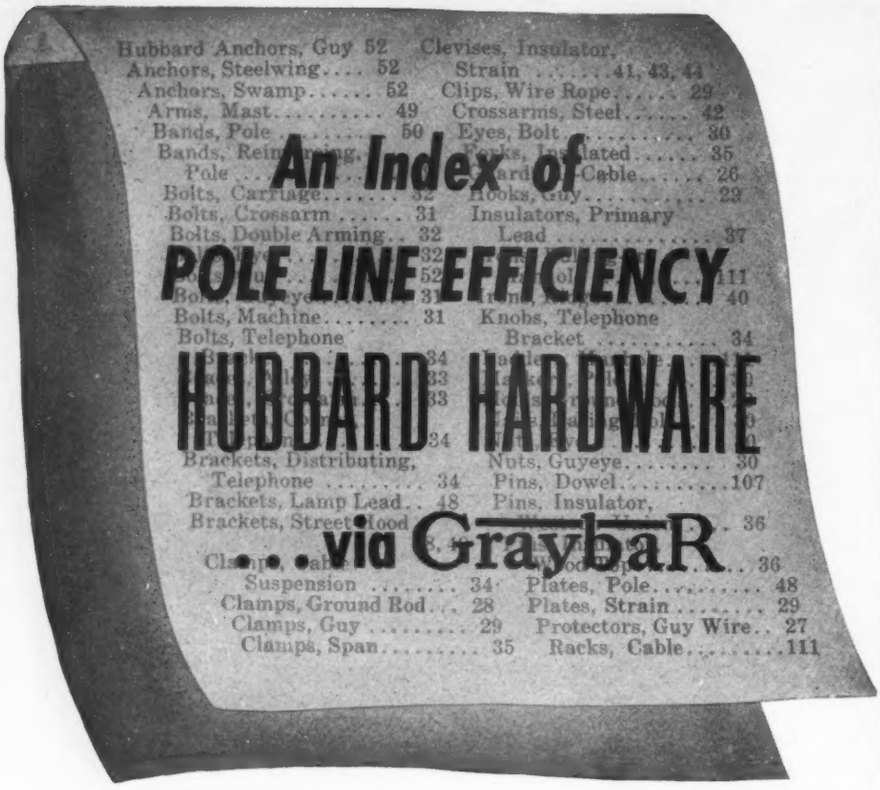
Over a half-century of forging experience is your assurance of dependable hi-line hardware.

A fully illustrated booklet outlining the history of forging sent free on request as long as the supply lasts.

FORGERS OF HI-LINE HARDWARE

THROUGH YOUR INSULATOR MANUFACTURER ONLY

YOU KNOW WITH A FORGING



When you check your needs under the name "Hubbard" in the GRAYBAR catalog, you're assuring yourself of efficient pole-line hardware performance from A to Z...from pole top pins to ground rods.

And whether it's standard guy clamps or cross-arm bolts you need, or an odd-sized street hood bracket, you are doubly assured of good value when you send the order "via GRAYBAR." You get prompt service, competent buying assistance, and exact conformity with the specifications of your order *plus* the satisfaction-insurance of the GRAYBAR tag.

Next time you need hardware—or any other pole line equipment or supplies—why not make it a point to reach first for your GRAYBAR catalog. Or, if you wish, write GRAYBAR direct for information, specifications, prices on any pole line need.

★ **Poles, Wire, Cable, Insulators . . . outside and inside wiring supplies.**

★ **Construction and Maintenance Tools.**

★ **Indoor and outdoor lighting equipment, G-E Mazda lamps.**

GRAYBAR ELECTRIC COMPANY

Offices in over 80 principal cities

Executive Offices

Graybar Bldg., New York

*GraybaR QUALITY SINCE 1869 *REG. U.S. PAT. OFF. Distributed by *GraybaR ELECTRIC COMPANY

Douglas Aircraft Gives York Third Contract

In the extension of its bomber production facilities at Long Beach, Calif., Douglas Aircraft Co. has awarded a contract for 26 separate air-conditioning systems to York Ice Machinery Corp. This award supplements a previous contract for 33 York systems in the original Douglas' Long Beach assembly plant executed last spring. The new windowless building is similar in construction.

In addition to these contracts, the refrigeration system for air conditioning Douglas' bomber assembly plant at Tulsa, Okla., is being furnished by York.

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Dividends Declared

Directors of Square D Co. have declared a dividend of $1.50 a share on the common stock, bringing the total common dividends declared in 1941 to $3.00 a share, compared with a total of $2.80 in 1940.

Other manufacturing companies that recently declared dividends include the following:

RELIANCE ELECTRIC & ENGINEERING, 50 cents per share on the common, bringing to $1.50 the amount for the year; last year, $1.37½.

ACME WIRE, 85 cents on the common, bringing 1941 payments to $2.65 a share, $1 more than 1940 disbursements.

CLARK CONTROLLER, 50 cents a share, bringing total this year to $2, or 25 cents more than last year.

•

Supplies Far-Flung Posts

Remodeling operations have been completed by the Airtemp Division of Chrysler Corp., Dayton, Ohio, to provide additional space for the manufacture of parts for the Bofors gun and the Martin medium bomber. Airtemp has been active on defense contracts for more than a year. To date more than 12,000 heating, cooling and refrigeration units have been shipped to various defense projects, with orders on hand calling for thousands of additional units.

New York Metal Prices

	Dec. 22, '41 Cents per Pound	Dec. 17, '41 Cents per Pound
Copper electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.85	5.85
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc, Spot	8.64	8.64
Tin, Straits	52.00	52.00
Aluminum, 99 percent	15.00	15.00

* Delivery Connecticut Valley.

Field Reports on Business

Tempo of industrial activity is speeding up as expenditures for armament materials mount. Because of war program, utilities are meeting difficulties in expanding of generating facilities. Small appliance sales continue high, but the demand for major units has declined.

PACIFIC COAST

Large shipments of wire, wiring supplies, condulets and roughing-in material are being assembled in coast cities for Hawaiian replacements. Merchants report close to normal sales of small appliances. New wiring installations will be maintained as close to red seal specifications as possible, though conforming with OPM limitations on number of outlets.

November building total, covering the seven western states, dropped 20 percent below October, but exceeded November last year by 40 percent. Inland and northwestern states ran even but California decreased 25 percent. Line construction is active, particularly in REA and substandard working. Medium jobs include $88,306 for 68 miles reaching 133 members in Tacoma area; $80,329 for 98 miles in Jefferson County, Ore., and $85,093 for San Juan County, Wash. Smaller awards, averaging $14,000 each, were made for Modoc County, Calif., and Okanogan County, Wash.

Outstanding were the $391,847 award to American Bridge Co. for building line No. 2 from Midway to Grand Coulee, and $194,900 for automatic telephone and alarm system for Naval Ammunition Depot at Hawthorne, Nev. A $5,000,000 aluminum reduction plant with 64,000 ton annual capacity is to be built near Los Angeles. Major machinery awards are $1,842,500 to Baldwin, covering two 115,000 hp. turbines for Boulder plant, and $559,785 to G.E. for three 25,000-kva. transformers for Keswick plant of California Central Valley project. Industrial business includes four 250 hp. motors, value $11,000, for a cement plant; $60,000 arc-welding equipment to a dealer and $40,000 of same to a shipyard; fifteen assorted transformers, sizes 100 to 500 kva., value $35,000, to a casting and forging plant, and a complete installation of miscellaneous electrical machinery equipment, costing $650,000, for expansion of Columbia Steel at Pittsburg on upper San Francisco Bay.

CHICAGO

With every effort being made to increase production for an all-out victory drive, the tempo of industrial activity in this area is rapidly increasing. Expenditures for armament materials in the Chicago Ordnance district have mounted rapidly in the past six weeks to pass the $596,000,000 mark. Plans are being speedily formulated to raise this total to approximately $1,500,000,000 as rapidly as is practical. Priorities clinics are being held and pools are being formed among thousands of small companies to bring all possible manufacturing facilities into the production of war equipment.

Electric power output increased 4,747,000 kw.-hr. over the previous week to show a gain of 11 percent over a year ago. The demand for electric appliances continues heavy with the number of shortages increasing each week. Inability of many manufacturers to meet the demands for a wide variety of electrical equipment keep the aggregate sales volume from showing much, if any, increase.

Bids have been requested by the Division of Contract Distribution for generator sets, turbo-generators, rubber-insulated cable, welding electrodes, electric furnaces, switches, relays, and rheostats. Defense orders placed last week for electrical equipment included American Automatic Electric Sales Co., telephone apparatus, $89,308; Hallecrafters Co., radio sets, $11,572; Nehring Electrical Works, copper wire, $17,361.

NEW YORK

Because of the difficulties with which utilities are being confronted in expanding their generating facilities, power production will have to be rationed eventually to meet the urgent requirements of the war program, authoritative observers agree. Government officials look for shortages and the necessity of rationing by 1943.

Reports indicate that unemployment in small business due to material shortages is likely to become severe in the near future. The decreased demand for major electrical appliances which started in the early fall has become more pronounced in the past two weeks. The current decline in sales is most marked in electric ranges and while refrigerator sales are seasonally low at this time of the year, there has been a greater-than-normal drop. The demand for small appliances for the Christmas trade continues high.

Engineering construction awards last week amounted to $66,966,000, an increase of 13 percent over the preceding week, but a decrease of 49 percent from the corresponding 1940 week, according to *Engineering News-Record.*

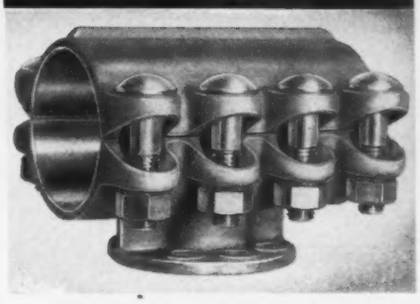
NEW ENGLAND

New England municipal water systems are showing active interest in electric pumping installations to overcome the effect of the record-breaking drought that has ranged through this district. Small motor orders continue to maintain a steady volume and according to one distributor are now marked as "repeats" ranging from allotments aggregating 10 hp. to groups totaling 500 hp. Small switches and control equipment demand is heavy. Calls for electric recording apparatus for process control are numerous. Alarm systems are in pressing need and municipalities along the eastern seaboard of this section are planning for new apparatus.

Defense contracts awarded during the past week were featured by the numerous small precision tool bookings, allotment of ammunition contracts to Connecticut manufacturers, and the purchase of supplies for the construction program being carried out at New England cantonments and naval bases. Wiring supplies, lighting fixtures, reflectors, small switch and control apparatus, and flood-lighting units are moving at a good rate.

Electrical contractors report spotty conditions in new construction. Air-conditioning installations in plants engaged in defense work are slowing down in the Massachusetts area and oil-burning equipment buying has slackened. Despite uncertainties of blackouts, most municipalities in this area will carry out their original plans for Christmas lighting. Department stores in the Boston area are recovering from a temporary setback in retail sales.

SOUTHERN STATES' SHORT-CUT*alog* NO. 3



Southern States Manufacturers

POWER CONNECTORS

for Every Purpose

Sound, thorough engineering goes into each Southern States connector, no matter how small it may be. Every connector . . . standard or special . . . is designed to give trouble-free service.

Southern States connectors are made from bronze alloy of high electrical conductivity. Oval-head or hexagon-head bolts of high tensile strength bronze are used in accordance with the needs of each particular connector. Bolts are so arranged as to insure high-pressure grip at all contact points. Clamping surfaces are machined for accurate, "hold-forever" connections that are kept tight with bronze lockwashers. Ample reinforcing ribs (where needed) are an integral part of each connector's design.

A summary of your connector problems will bring detailed drawings of connectors to fill your needs. If you prefer, write for Bulletin 500 which gives a broadside of Southern States connectors.

Left: Typical Southern States T-connector.

Below: Southern States parallel groove clamp. Southern States connectors cover the range from this tiny clamp to any maximum size you require.

WHAT IS YOUR ENGINEERING PROBLEM?

Whether it has to do with connectors, fusing, switching or complete substation design, Southern States wants to work with you. So when you have a problem, let us help.

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Equipment (SS) Corporation

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SHORT LEFT-LEGGED COWS

for Grazing on Hilly Terrain

While cows to the above specifications are probably a biological impossibility, relays designed to meet almost equally unusual specifications are pretty much an everyday occurrence at Dunco. We're producing special, hard-to-get relays and timers regularly for everything from aviation jobs, to tank jobs and a host of other military uses, as well as for countless industrial applications.

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Already a favorite with many utilities because of its many uses. With it you need stock only one insulator for standard medium voltage lines and arc light circuits.

Its Outstanding Features

- *lower groove has ample insulation for 6600* volts.
- *on corner turns, wire can be dropped into lower groove . . . increasing strength of pin and reducing possibility of both pin-bending and pin-breakage.*
- *has long leakage path.*
- *has high impact strength.*

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OWENS-ILLINOIS

HEMINGRAY DIVISION, MUNCIE, INDIANA

Sales Opportunities

MILWAUKEE, WIS. — Wisconsin Electric Power Co. plans addition to indoor power substation at North Green Bay and West Atkinson Avenue, with installation of two new 10,000-kva. transformers, switchgear and auxiliary equipment. Negotiations are under way for purchase of adjoining land and work will be carried out early in 1942. Project will include extensions in transmission lines for increased load.

SLATER, IOWA—Town Council receives bids until January 13 for new municipal power plant, including two Diesel engine-driven generating units and auxiliary equipment. Also for distribution lines. Ralph W. Gearhart, 349 Twenty-first Street, S.E., Cedar Rapids, Iowa, is consulting engineer.

MORGANTOWN, W. VA.—E. I. du Pont de-Nemours & Co., Inc., duPont Building, Wilmington, Del., plans installation of motors and controls, transformers and accessories, switchgear, fluorescent lighting system, duct lines, conveyors and other equipment in new plant at Morgantown for production of warfare chemicals for government. It will comprise several large one and multi-story buildings, equipped for heavy output. Cost estimated about $15,000,000, with fund in that amount to be provided by Defense Plant Corporation, Washington, D. C., for land, buildings and equipment. This will be an extension of project now in progress at same place by duPont company for manufacture of synthetic ammonia, likewise for government, and which will represent a total cost approximating $40,000,000, developing a gross expenditure of $55,000,000 for complete project. Chemical works will occupy an adjoining tract of land.

LANSING, MICH.—United States Property and Disbursing Officer, National Guard Bureau, Lansing, receives bids until January 6 for quantity of electrical equipment, including 3,500 lin. ft. of solid copper wire, 1,430 ft. of copper wire, strain insulators, cedar poles, cross arms, pin-type insulators, ground rod clamps, three transformers, lightning arresters, etc. (Invitation 38-2).

WATERLOO, WIS.—Water and Light Commission, City Hall, receives bids until January 6 for extensions and improvements in municipal power station and central-heating plant, including installation of a bleeder-type steam turbine-generating unit, with surface condenser and accessories, switchboard panel, motor-driven pumping equipment, motors, controls and miscellaneous apparatus; also for a steam-generating unit, coal-fired, with stoker, coal-handling equipment, forced and induced draft apparatus, etc. Commercial Testing & Engineering Co., 307 North Michigan Avenue, Chicago, Ill., is consulting engineer.

PORTLAND, ORE. — Purchasing Officer, Bonneville Power Administration, Department of Interior, 811 N.E. Oregon Street, Portland, receives bids until January 5 for carrier communication equipment (postponed from December 15) (Circular 2391).

CANDO, N. D.—Baker Electric Cooperative, Inc., Baker, N. D., Palmer Stadum, superintendent, has negotiations under way for purchase of electric generating station of Central Electric & Telephone Co., Sioux City, Iowa, at Cando, to be used for power supply for rural electric lines in future. Extensions and improvements are planned, with installation of additional generating unit and auxiliary equipment.

SEATTLE, WASH.—Bethlehem Steel Co., plans installation of motor-generator set, heavy-duty motors and controls, switchgear,

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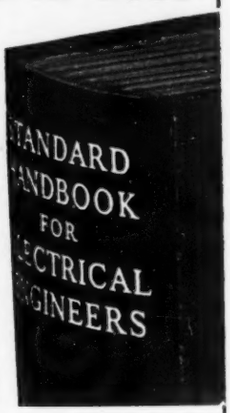

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transformers and accessories, duct lines, interior and exterior lighting systems, electric furnaces and auxiliaries, conveyors, electric hoists, cranes and other equipment in proposed additions to local mill for steel production for government. New units will occupy adjoining tract of land and are estimated to cost about $12,000,000. Defense Plant Corporation, Washington, D. C., is now considering details of project and approval of fund in amount noted is scheduled at early date. Main offices of company are at Bethlehem, Pa.

WASHINGTON, D. C.—Bureau of Supplies and Accounts, Navy Department, Washington, receives bids until January 6 for two 750-kw., 450-volt turbine-generators, two circuit breakers and spare parts (Schedule 9742) for Eastern and Western navy yards; also, until January 9 for nine 500-kw. Diesel engine-driven generator sets with accessories, for emergency power service (Schedule 9721) for Brooklyn, N. Y., Philadelphia, Pa., and Norfolk, Va., navy yards; until January 13 for quantity of motor-driven centrifugal pumps for various water service (Schedule 9711) for Eastern and Western navy yards.

SPOKANE, WASH.—Bonneville Power Administration, Department of Interior, 811 N.E. Oregon Street, Portland, Ore., has plans under way for new power substation on site about six miles from Spokane, for power supply for new aluminum reduction plant to be constructed in that district by Aluminum Co. of America, Inc., Gulf Building, Pittsburgh, Pa., for production for government. Substation is estimated to cost about $1,350,000, including transmission line from connection with Grand Coulee high-tension system to that point. Bids are scheduled to be asked soon.

HOUSTON, TEX.—Hughes Tool Co., 300 Hughes Street, manufacturer of oil well drilling tools and kindred products, plans installation of motors and controls, transformers and accessories, duct lines, fluorescent lighting system, switchgear, conveyors, electric hoists, electric cranes and other equipment in new plant near Houston for production of gun tubes and cannons for government, to be known as Dickson Gun Plant. It will comprise several large one-story buildings, with power station for central station service and auxiliary structures. Cost estimated at $12,000,000. Fund in that amount will be furnished by Defense Plant Corporation, Washington, D. C., for project.

•

G.E. Gets DPC Contract

Defense Plant Corporation has authorized the execution of a contract with General Electric Co., for construction and equipment of a plant at Erie, Pa., at a cost of $10,430,288, to be used in the production of naval equipment.

•

Order Keswick Equipment

Three transformers have been ordered by Secretary of the Interior Harold L. Ickes for the Keswick power plant on the Central Valley project in California. General Electric Co. will furnish three 25,000-kva. power transformers on its bid of $559,785.

NATIONAL DEFENSE DEMANDS *You*

Keep Your System at the PEAK

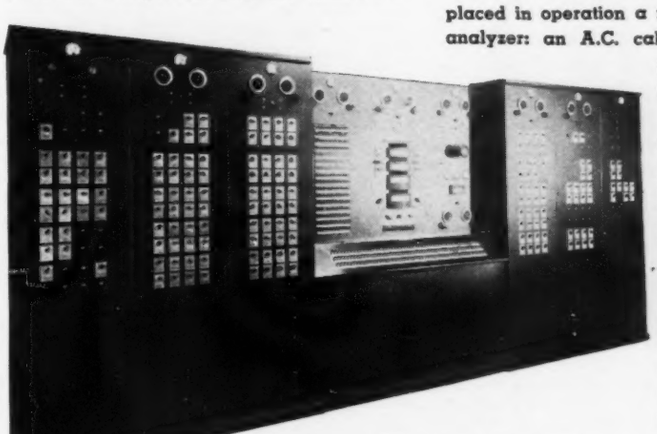
of Effectiveness and Efficiency!

IN these days of strenuous defense preparation, industry must be assured of uninterrupted sufficient power to meet their expanding needs; present networks must be operated at maximum capacity and still assure good voltage regulation at all points.

This can be done only by continuous revision of operation methods to meet ever-repeating new requirements imposed upon the system. Such revisions are determined by having available up-to-date information on power flow, voltage regulation, magnitude and disposition of fault currents that will prevail after the connection of new loads or lines. This information can be known accurately by preceding such changes with a system analysis study made on a A.C. calculating board.

The common practice of predicting required system changes and operation by means of approximate calculations and then revising these plans after studies are made of resulting system interruptions when these plans are tried out need no longer be tolerated. Now it is possible to have accurate and immediately available information on how to meet the requirements of new load centers or new lines.

There has been recently developed and placed in operation a new type of system analyzer: an A.C. calculating board designed especially for the system to be represented. By employing this new principle and by the use of new type apparatus, the size and cost of A.C. calculating boards have been reduced to such an extent that it is now possible for electric utility companies to justify the ownership of their own system analyzer.



The PHILLIPS A.C. SYSTEM ANALYZER
in use by a Mid-Western Company

SPECIAL FEATURES

1. Designed especially to represent system and inter-connections.
2. Readily enlarged to meet system growth, thus requiring no unnecessary surplus of equipment and investment on installation.
3. Does not require a special frequency source for its power supply.
4. All units adjustable with exception of impedance units representing permanent system network lines.
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6. Simplified master metering system that requires no vacuum tubes.

SYSTEM APPLICATIONS

1. For determining circuit breaker capacity required and relay coordination for any type fault with system operating under load conditions.
2. For determining the most economical one of several alternative methods required for system extensions resulting from increased loads.
3. Voltage-regulation studies.
4. Power-flow investigations.
5. Steady-state stability studies within the system or between the system and its inter-connected systems.
6. Transient-state stability studies within the system or between the system and its inter-connected systems.

We will be pleased to furnish you with additional information and a cost estimate for application to your system.

NELSON ELECTRIC MANUFACTURING CO.

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GALVANIZED STEEL
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All the inherent strength and ruggedness that steel alone provides are combined with long life and definite economies in *Crapo* Galvanized Steel Strand. Each size and grade develops the full tensile strength of the steel in its complete cross-section. The heavy, ductile, tightly-bonded zinc coating—applied by the famous *Crapo* Galvanizing Process—affords lasting protection against corrosion, extends the life of the strand beyond the normal period for replacement.

Low first cost, workability in the field, consistent, trouble-free performance and low maintenance expense characterize the service history of this time-tested product. There is a size and grade of *Crapo* Galvanized Steel Strand for every practical need. Consult the distributor of *Crapo* Galvanized Products near you or write direct for further information!

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REA Announces Recent Allotments

Allotments totaling $6,284,500 covering rural electrification in various states have recently been announced by the Rural Electrification Administration.

According to Administrator Harry Slattery, none of these allotments contemplates the purchase of new supplies or metals or equipment. In each case the funds will be used to pay for excess costs of construction already contracted for and practically complete, to acquire existing properties or to utilize materials already on hand.

These allotments bring the total since the establishment of REA in 1935 to $432,016,321, of which $63,188,700 represents operations during the current fiscal year.

Among the recent allotments are the following:

ALABAMA—Sand Mountain Electric Membership Corp., Fort Payne, M. C. Stewart, supt., $132,000 to build 75 miles of line, 385 members in Jackson and DeKalb counties. Tallapoosa River Electric Cooperative, Inc., Lafayette, Jesse Drake, supt., $35,000 to complete a section of the system and install a substation.

ARKANSAS—Woodruff Electric Cooperative Corp., Augusta, T. E. Bostick, manager, $60,000 to build 55 miles of line, 252 members in Woodruff, Cross, St. Francis, Lee, Phillips and Monroe counties.

CALIFORNIA—Plumas-Sierra Rural Electric Cooperative, Portola, E. J. Shelley, supt., $44,000 for the construction of 44,000-volt feeder line and 44-kv. substation, and to connect 49 new members. Surprise Valley Electrification Corp., Alturas, Jesse M. Grigsby, manager, $14,000 to complete a section of the system.

COLORADO—Morgan County Rural Electric Assn., Fort Morgan, W. L. Parker, supt., $228,000 to build 154 miles of line, 292 members in Adams, Washington, Morgan, Weld and Logan counties. Empire Electric Assn., Inc., Dove Creek, Cecil E. Stokes, supt., $215,000 to build 201 miles of line, 431 members in Dolores and Montezuma counties. Grand Valley Rural Power Lines, Inc., Grand Junction, I. W. Patterson, supt., $90,000 to build and acquire 87 miles of line, 319 members in Mesa County.

FLORIDA—Florida Keys Electric Cooperative Assn., Inc., Marathon, Ross Sawyer, coordinator, $208,000 to build and acquire 115 miles of line, 686 members in Monroe County; $91,000 for the construction of two generating plants.

GEORGIA—Georgia Rural Power Reserve Electric Membership Corp., Louisville, $3,750,000 for the construction of three steam generating plants and 756 miles of 44-kv. transmission line. Amicalola Electric Membership Corp., Jasper, A. C. Moore, supt., $165,500 to build and acquire 197.5 miles of line, 1,061 members in Pickens, Gilmer, Gordon, Cherokee, Dawson and Lumpkin counties, and in the villages of Tate, Nelson and Marble Hill.

KENTUCKY — Jackson-Purchase Rural Electric Cooperative Corp., Paducah, C. D. Harris, supt., $175,000 to build and acquire 97 miles of line, 957 members in Carlisle, Graves, Livingston, McCracken, Ballard and Marshall counties. Green River Rural Electrification Cooperative Corp., Owens-

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INSULATED TOOLS

Reduce accidents and service interruptions

COHARDITE insulation molded on H.K. Porter bolt cutters protects the Linemen and equipment with a tested 20,000 volts dielectric. Available in #0, #1, and #2 sizes with either rigid or swivel head.

Every tool tested to its full rated dielectric strength for one minute R.M.S. before it leaves our plant.

A full range of COHARDITE insulated small tools carried in stock for Meter and Distribution Departments.

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The Connecticut Hard Rubber Co.
NEW HAVEN, CONNECTICUT

BURNDY LUGS

BURNDY Engineering Co., Inc.
459 East 133 St., N.Y.

boro, C. T. Smith, supt., $143,000 to build and acquire 118 miles of line, 470 members in Hancock, Ohio, McLean, Daviess, Hopkins and Webster counties. Meade County Rural Electrification Cooperative Corp., Brandenburg, C. H. Brown, supt., $90,000 to build and acquire 69 miles of line, 383 members in Breckenridge, Ohio and Grayson counties. Cumberland Valley Rural Electric Cooperative Corp., Pineville, J. S. Broaddus, supt., $40,000 to complete a section of the system and to connect 150 new members.

MARYLAND—Choptank Cooperative, Inc., Denton, C. A. Sennett, supt., $59,000 to build and acquire 15 miles of line, 30 members in Dorchester county. Southern Maryland Tri-County Cooperative Assn., Inc., LaPlata, Forrest Coakley, $34,500 to complete a section of the system.

MISSISSIPPI—Jones County Electric Power Assn., Laurel, S. L. Smith, supt., 20,000 to complete a section of the system.

MISSOURI—Missouri Rural Electric Cooperative Assn., Palmyra, H. C. McAfee, manager, $15,000 to complete a section of the system; $10,000 to purchase office headquarters building.

NEBRASKA—Gering Valley Rural Public Power District, Gering, W. F. McGriff, supt., $26,000 to build and acquire 29.25 miles of line, 85 members in Scotts Bluff County.

PENNSYLVANIA—Claverack Electric Cooperative, Inc., Towanda, Clarence E. Jakway, manager, $29,500 to complete a section of the system.

SOUTH CAROLINA—Aiken Electric Cooperative, Inc., Aiken, T. W. Henderson, supt., $96,000 to build 80 miles of line, 318 members in Aiken, Orangeburg, Saluda, Edgefield, McCormick, Lexington and Barnwell counties. Lynches River Electric Cooperative, Inc., Pageland, W. A. Cauthen, supt., $50,000 to complete a section of the system. Broad River Electric Cooperative, Inc., Gaffney, G. G. Inman, supt., $27,000 to complete a section of the system. Mid-Carolina Electric Cooperative, Inc., Lexington, M. Wise Caughman, supt., $20,000 to complete a section of the system.

TEXAS—Pedernales Electric Cooperative, Inc., Johnson City, Lee McWilliams, supt., $65,000 to complete a section of the system. Panola-Harrison Electric Cooperative, Inc., Elysian Fields, K. A. Crawford, manager, $10,000 to complete a section of the system.

VIRGINIA—B.A.R.C. Electric Cooperative, Millboro, M. R. Seabrooke, supt., $48,000 to complete a section of the system. Shenandoah Valley Electric Cooperative, Dayton, L. E. Long, supt., $15,000 to complete a generating plant.

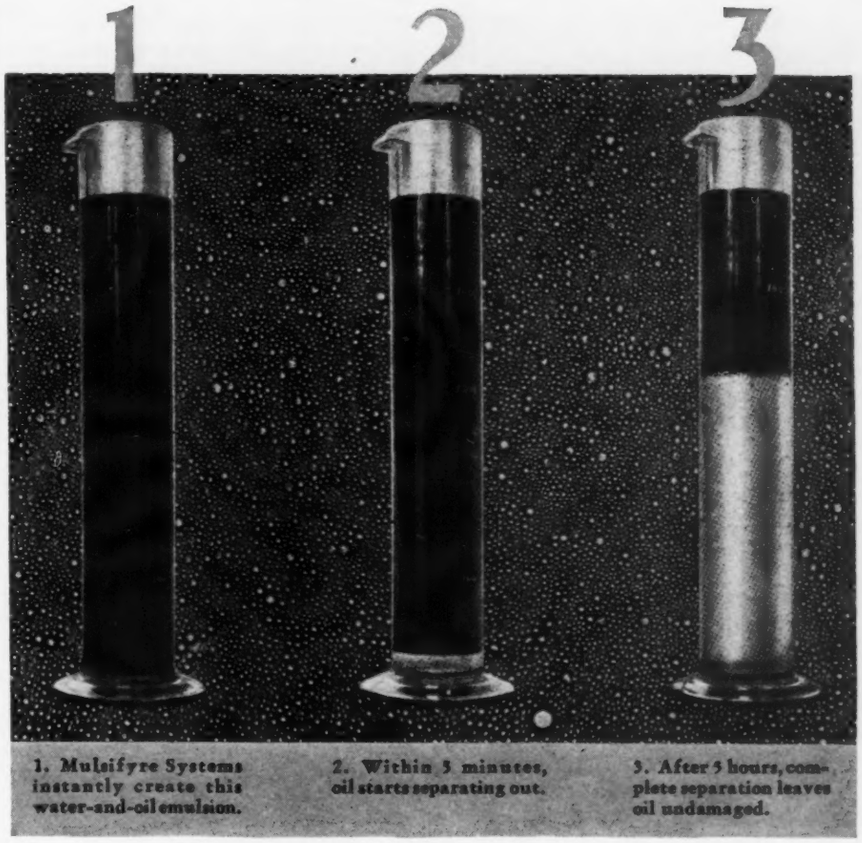
WASHINGTON—Big Bend Electric Cooperative, Inc., Ritzville, Harry H. Hudlow, supt., $170,000 to build 185 miles of line, 192 members in Adams and Franklin counties. Okanogan County Electric Cooperative, Inc., Winthrop, William F. Dixon, acting manager, $14,000 to complete a section of the system.

WISCONSIN—Tri-State Power Cooperative, Genoa, John N. Gundershaug, manager, $48,000 for additional facilities in connection with a generating plant. Dunn County Electric Cooperative, Menomonie, Martin B. Rotnem, supt., $40,000 to build 46 miles of line, 103 members in Dunn, Chippewa and Pepin counties.

WYOMING—Lower Valley Power and Light, Inc., Freedom, Easton Hood, supt., $7,000 for additional facilities in connection with a generating plant.

Positive Oil-Fire Protection

.....SIMPLE AS



1. Mulsifyre Systems instantly create this water-and-oil emulsion.

2. Within 5 minutes, oil starts separating out.

3. After 5 hours, complete separation leaves oil undamaged.

Unique Mulsifyre Systems churn oil surfaces into non-flammable water emulsion!

All you need to do is install Mulsifyre Systems on oil-filled apparatus, and you're permanently equipped to put out oil fires promptly and without damage to equipment.

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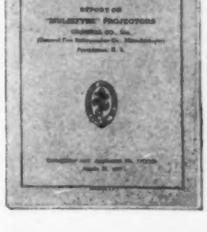

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6 points ¼"x½" in size grip the pole securely but leave no deep hole to encourage rot and decay.
Furnished in small, medium and large sizes for handling poles up to 22" in diameter. Prices and complete description on request.
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Recent Rate Changes

CENTRAL ILLINOIS PUBLIC SERVICE CO. has been ordered by the state Commerce Commission to reduce its electric rates in 57 cities by approximately $160,000 annually. The new rate schedule will result in an average cut of 7.5 percent for all company customers using electricity under the residential service rates. Minimum bill customers are excepted. The new schedule is effective for meter readings after next January 1.

NEW YORK STATE ELECTRIC & GAS CORP. has been granted permission by the state Public Service Commission to put into effect revised electric schedules for primary service in its Lancaster territory which includes a number of communities in Erie, Wyoming, Cattaraugus and Chautauqua counties. The revisions will result in a reduction of more than $12,000 per annum to industrial customers and will become effective December 31 next.

ILLINOIS COMMERCE COMMISSION put into effect rate changes effective during the month of November, which resulted in an estimated decrease of $105,357 in annual operating revenues. Electric rate reductions accounted for $25,015 of this reduction.

MONMOUTH, ORE., has announced a second reduction in electricity rates to residential and commercial customers of its municipal power system. The reduction will save electrical consumers about $2,000 a year. The new residential rate has the same energy charges as the Bonneville standard rate schedules. Mayor R. F. Bowersox has notified Paul J. Raver, Bonneville Power Administrator, residential rates will be reduced one-half cent per kilowatt-hour on the first 100 kw.-hr. used per month starting December 21. Reduction in price to commercial customers brings the charge for the first 150 kw.-hr. to 3 cents per kilowatt-hour and on the next 350 kw.-hr. to 2 cents.

McMINNEVILLE (Ore.) Water and Light Commission has adopted the Bonneville standard resale rates for the distribution of Columbia River power in that community. The commission has advised Administrator Raver that it has adopted the Bonneville standard rates, which will mean a reduction of approximately $10,000 a year in the cost of electric service to consumers.

•

PUD, Bonneville Board Arrange Power Contract

Bonneville Power Administration officials have announced details preliminary to execution of a contract for power between the Benton County (Wash.) public utility district and the Bonneville Administration have been arranged, following meetings between executives of the two agencies.

The tentative contract discussed provides for the PUD to purchase power at the Bonneville optional prime power rate of one-quarter cent a kilowatt-hour of monthly use plus 75 cents per kilowatt of monthly demand. It provides that the PUD will sell the power at retail rates agreed upon between the Bonneville Administration and the PUD.

These Sherman Set Screw Connectors

Save a Lot of Work and Trouble

74
SHERMAN
2 Types
Both 2-screw and 4-screw styles available with dividing wall, for stranded cable, or with wire hole extending clear through, suitable for either solid or stranded cable.
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SHERMAN

Sherman Set Screw Connectors are made to speed up jobs and cut costs. They are easy to use, and make a tight, dependable connection for either temporary or permanent work. Machined from solid brass rod, with all dimensions and proportions held to accurate limits. Screws heavily rustproofed. Number plainly stamped on each connector.

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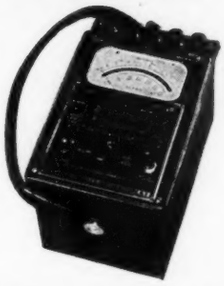
Battle Creek, Michigan

Insulation Tests Simplified!

In Stock for prompt shipment



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Ranges: 0-200 Megohms
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0-300 & 0-600 Volts DC

No more tiresome cranking of a hand driven generator.

Steady test voltage of 500 volts DC instantly available, at the touch of a push button. Direct readings of insulation resistance obtained on special color-graded scale without any calculations.

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for details of design and operation of this radically new instrument.

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HARD PORCELAIN
FOR
Electrical Specialties
High and Low Voltages

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RUSH JOBS balked by "delivery-in-six-months," can often be solved by turning to another source of supply.

Then, your *first source of information* is Electrical Buyers Reference. Complete product classified listings of 3500 manufacturers, trade name index, and so on, make Electrical Buyers Reference the first thought of busy electrical men who buy and specify, who need data on new lines, new sources of material.

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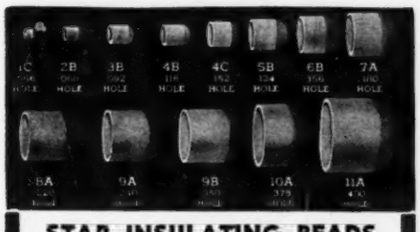
Use your Electrical Buyers Reference regularly —to save time and money

ELECTRICAL BUYERS REFERENCE

A unit of the McGraw-Hill Reference Service
330 West 42nd Street New York, N. Y.



STAR INSULATING BEADS

Use **Lavolain** ball and socket beads for insulating bare wire. Heat resistant. High di-electric and mechanical strength. Made in U. S. A. Quality beads at low cost. Quickly applied. Flexible. Beads shown above are approximately half actual size. Ask for price list and samples.

STAR PORCELAIN CO.
TRENTON, N. J.

Heating Steam Requirements Fix Commerce Street Design

[*Continued from page 49*]

plied to the heating system from the turbine. In addition, steam for heating feedwater is also being extracted, as well as steam for driving the boiler feed pump. The exhaust from the feed pump turbine can be sent to the low-pressure heating main or to the No. 2 extraction heater.

Rated 35,000 kw., 85 percent power factor at 3,600 r.p.m., the 13.8-kv. generator is hydrogen-cooled and has a geared exciter. The turbine is a high-pressure, condensing, automatic-extraction, tandem-compound, opposed-flow exhaust machine using steam at 1,200 lb. pressure, 900 deg. F. temperature. Maximum extraction is possible at 24,000 kw. load with a flow of 375,000 lb. per hour to throttle and 240,000 lb. per hour extracted at 35 lb. and 160 lb. plus feedwater extraction.

There are five extraction nozzles. One is automatic (No. 2) and extracts steam at 35 lb. gage at high-pressure turbine exhaust. Of the four uncontrolled, Nos. 3, 4 and 5 are in the higher pressure turbine and No. 1 in the low-pressure turbine. Nozzles Nos. 2 and 4 are heavy commercial bleedpoints. Steam for feedwater heating is extracted from Nos. 1, 2, 3 and 4 nozzles. No. 5 is used for supplying high-pressure steam at light loads.

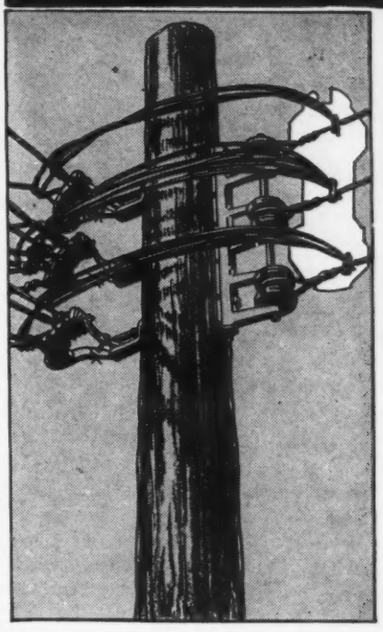
Pressure at the automatic extraction nozzle (crossover pipe) on 35,000-kw. load, zero automatic extraction (but including feedwater extraction), rises to 58 lb. gage. With standard tandem-compound units of this size crossover pressure is about 10 lb. gage and the low-pressure cylinder between the two cast-iron exhaust end sections is also made of cast iron. At Commerce Street this low-pressure cylinder is of welded steel to take care of the increased thermal expansion caused by higher entering steam temperature.

•

Will Build New Plant

Hygrade Sylvania Corp., Salem, Mass., has plans maturing for new branch plant in vicinity of Williamsport, Pa., where tract of about 16 acres of land has been secured near city limits.

modernize
YOUR
DISTRIBUTION
PRACTICE—



RELIABLE MULTI-TAP CONNECTORS

Provide neater more economical connection of service drop pigtails to secondary in crowded alley distribution.

One size accommodates No. 2 line wire and six No. 6 taps in a close fitting slot that assures dependable connections.

Reliable
ELECTRIC COMPANY
OVER 30 YEARS SERVICE TO THE UTILITIES
3143 CARROLL AVENUE • CHICAGO, ILLINOIS

Defense Savings Pay-Roll Allotment Plan

How company heads can help their country, their employees, and themselves

voluntary pay-roll allotment plan | helps workers provide for the future; helps build future buying power; helps defend America today

This is no charity plea. It is a sound business proposition that vitally concerns the present and future welfare of your company, your employees, and yourself.

During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly*.

Let's do it the American way! America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will*.

In emergencies, America doesn't do things "hit-or-miss." We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

Each employee who chooses to start this savings plan decides for himself the denomination of the Bonds to be purchased and the amount to be allotted from his wages each pay day.

How big does a company have to be? From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up

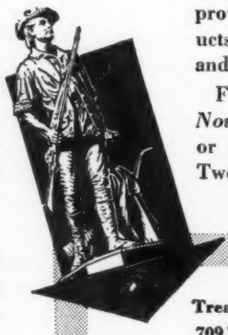
No chore at all. The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.

Plenty of help available. Although this is *your* plan when you put it into effect, the Treasury Department is ready and willing to give you all kinds of help. Local civilian committees in 48 States are set up to have experienced men work with you just as much as you want them to, and no more.

Truly, about all *you* have to do is to indicate your willingness to get your organization started. We will supply most of the necessary material, and no end of help.

The first step is to take a closer look. Sending in the coupon in no way obligates you to install the Plan. It will simply give you a chance to scrutinize the available material and see what other companies are already doing. It will bring you samples of literature explaining the benefits to employees and describing the various denominations of Defense Savings Bonds that can be purchased through the Plan.

Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.



France left it to "hit-or-miss" . . . and *missed*. *Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

FREE - NO OBLIGATION

Treasury Department, Section A,
709 Twelfth St. NW., Washington, D. C.

Please send me the free kit of material being used by companies that have installed the Voluntary Defense Savings Pay-Roll Allotment Plan.

Name _____

Position _____

Company _____

Address _____

This space contributed by ELECTRICAL WORLD

1942 EDITION NOW READY

This new edition, hot off the press, contains the latest catalog data of leading manufacturers, plus a complete directory of the makers of electrical and allied products—and a wealth of other valuable data to help you in your specifying and buying throughout the year.

This dramatic insert will introduce the Manufacturers' Catalog Section in the 1942 Edition.

MANUFACTURERS "BRIEFALOG" SECTION

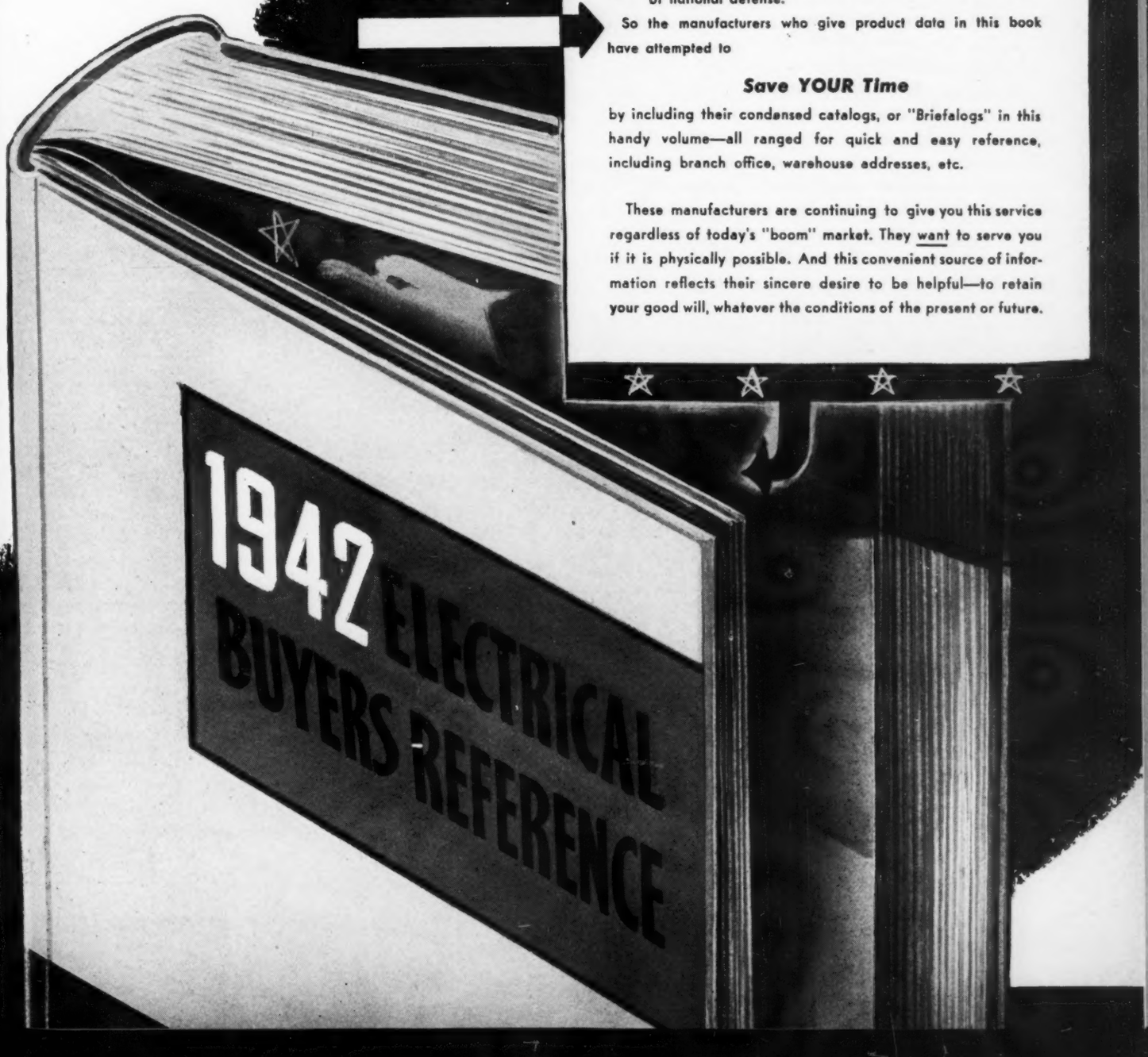
★ Time is money today. Even more, it is a vital ingredient of national defense.

So the manufacturers who give product data in this book have attempted to

Save YOUR Time

by including their condensed catalogs, or "Briefalogs" in this handy volume—all ranged for quick and easy reference, including branch office, warehouse addresses, etc.

These manufacturers are continuing to give you this service regardless of today's "boom" market. They want to serve you if it is physically possible. And this convenient source of information reflects their sincere desire to be helpful—to retain your good will, whatever the conditions of the present or future.



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Construction

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Inspections
Cost Analysis
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BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

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Recording & Statistical Corp.

BILL ANALYSIS—CONSUMPTION STUDIES
THE ONE-STEP METHOD
• *Bill Frequency Analyzer*
102 Maiden Lane New York

BLACK & VEATCH

Consulting Engineers

Water, Steam and Electric Power Investigations, Design, Supervision of Construction, Valuation, Tests and Laboratory Service.

4706 Broadway, Kansas City, Mo.

FRANK F. FOWLE & CO.

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35 East Wacker Drive Chicago, Ill.

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Engineers
for the
FINANCING—REORGANIZATION—
DESIGN—CONSTRUCTION—
of
INDUSTRIAL and PUBLIC UTILITIES
Chicago New York San Francisco

H. T. CANFIELD ENGINEERING ASSOCIATES

Reports, Investigations, Valuations, Rates Regulatory Problems and Proceedings Design, Supervision of Construction

61 Broadway New York

HOOSIER ENGINEERING COMPANY

Erecting Engineers
Transmission Lines, Substations
46 So. 5th St., Columbus, Ohio
327 South LaSalle Street, Chicago, Ill.
136 Liberty St., New York

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

E. J. CHENEY AND CO.

Engineers and Consultants

Design, Supervision of Construction
Rehabilitation Engineering, Reports, Studies
Valuations, Economic and Business Surveys

61 Broadway New York

WILLIAM S. LEFFLER

succeeding
CHARLES F. LACOMBE—WILLIAM S. LEFFLER
Engineers — Economists
Public Utility Management Problems
Economic Audits for Selective Load Building
Balanced Domestic Load Development
Cost Analysis—Rate Cases
Noroton, Connecticut

SPOONER & MERRILL, INC.

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20 North Wacker Drive, Chicago, Illinois

HUGH L. COOPER & CO.

General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.

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CHAS. T. MAIN, INC.

Engineers
Boston, Mass.

Electric, Steam and Hydraulic Projects. Investigations, Reports, Designs and Appraisals.

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BOSTON • NEW YORK • CHICAGO
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Consulting Engineers
Hydro-Electric Development, Dams, Water Supply, Flood Control. Engineering Problems relating to Water Rights and Water Power Law. Appraisals.
New York City, 50 Church St.

THE J. G. WHITE ENGINEERING CORPORATION

Engineers — Constructors

New York, N. Y.

ROBERT E. FOLEY CONSTRUCTION CORPORATION

Rural Lines—Transmission Lines
Fire Alarms—Telephone Lines

48 Griswold St. Binghamton, N. Y.

ARTHUR L. MULLERGREN

Engineering-Management
Public Utilities—Natural Gas

Kansas City, Mo.

CONSULT THESE SPECIALISTS:

Let them save your time by bringing their broad experience in their specialty to bear on your problems.

Portable Show Boosts Industrial Lighting

[*Continued from page* 43]

equipment (fixtures were loaned by manufacturers) was assembled at a cost of about $300 to $400. When it has served its present industrial promotion duty slight modifications will permit much of the equipment to be used in commercial and domestic lighting promotion by merely changing the lecture and the type of fixtures displayed.

The demonstration has not been in use long enough to determine its full value, but the responses have been highly satisfactory, as may be judged from the typical results of four demonstrations made so far in the company's southern division at Kankakee, Streator, Chicago Heights and Blue Island. These meetings were attended by a total of 206 industrial representatives, most of whom were the influential representatives of the industry rather than minor employees. As a result of follow-up, seventeen industrial plants have been surveyed and fourteen major lighting recommendations involving 280 kw. of improved lighting have been submitted.

The display was designed by G. K. Hardacre, lighting supervisor of the company, and has been made available to the three divisional lighting sales departments throughout the company where divisional specialists have been trained to give the demonstration lectures.

Quiz Programs Enliven Safety Programs

[*Continued from page* 59]

infractions. Audience interest was excellent.

However, so that this phase of the program would not leave a negative impression, a second part was devised. This consisted of a 2,000-ft. Kodachrome talking picture in which the right way of doing the various jobs shown in the "haywire" shots was portrayed. A scenario contest was conducted among all employees and a story prepared from the winning submission. A commercial organization shot the film, taking approximately 4,000 ft. This was edited to 2,000 ft. and the narration synchronized with the action.

The success of this type of program has given the committee a cue for the future. Right now plans are under discussion for 1942.

•

Dairy Council Presents Electrification Plan

"It pays to Electrify Your Dairy" is the theme of a 14-page consumer booklet issued by the Electric Dairy Council to help promote greater profits in dairying through the use of electricity. Five types of electric dairy equipment are described in the booklet—milking and separating, grinding and mixing feed, cooling and refrigeration, and controlled ventilation.

The booklet, entitled "A Five-Point Plan for Profitable Dairy Improvement," stresses the decreased labor and production costs, the higher grade products, better prices and increased profits made possible by use of these five types of equipment. The booklet is attractively presented, with wash drawings to show the equipment in action. Copies may be ordered from the Electric Dairy Council, 420 Lexington Avenue, New York City.

•

Orders New Equipment for Grand Coulee Plant

Oil circuit breakers, disconnecting switches and lightning arresters have been ordered by Secretary of the Interior Harold L. Ickes for the Grand Coulee power plant.

Contracts totaling $512,924 have been awarded to three manufacturing companies as follows: General Electric, four 230-kv. oil circuit breakers complete without oil within 300 days on its bid price of $206,920; Westinghouse Electric & Manufacturing Co., for $158,004, will furnish two 230-kv. oil circuit breakers and two 230-kv. lightning arresters within 300 days; Bowie Switch Co., on its bid price of $148,000, will furnish seventeen 230-kv. and eleven 115-kv. disconnecting switches within 200 days.

•

FPC Drops Proceedings

Federal Power Commission has dismissed the show cause proceedings concerning the failure of Iowa Union Electric Co., Keokuk, to comply with the original cost accounting requirements of the commission's Uniform System of Accounts. The order of dismissal follows approval of certain adjustments made in accordance with those proposed by the commission.

HOW TO BUILD future BUSINESS by solving IMMEDIATE problems

Company heads find advertising can solve many customer-relations problems other than selling goods

TODAY many company officers are discovering that advertising is a *vehicle of communication;* simply an economical way to get *any* important messages to customers and prospects, quickly and accurately.

Useful *advertising pays today*

One thing you can be sure of today is that *everybody* has new and perplexing problems. Advertising designed to help customers and prospects solve some of those new problems, *right now,* builds *enduring* good-will.

FOR EXAMPLE: A vacuum cleaner manufacturer, short of materials, uses his dealer publication advertising to show retailers how they can keep their doors open, and hold their customers' good-will, by building up the service end of their business. Thus he *helps* them, even though he can't supply much more than spare parts, right now.

Manufacturers of refrigerators, washing machines, electric irons, or *any* home appliances can find ways to make their dealer paper advertising equally useful.

Generalities help no one

Harassed business men *scour* business papers for *useful* ideas. They'll *study* anything that looks helpful, but they have no time for platitudes or boasts. Business papers offer the *opportunity* to work out advertising that is of *specific* use to special groups of customers and prospects.

That kind of advertising merits managerial attention. Company officers must make sure that they have competent advertising help, must provide adequate funds to achieve sound advertising objectives, and, above all, must give their advertising people encouragement, help, and responsibility.

"How To Find Out What To Say In Your Business Paper Advertising Today"

That is the title of a new A.B.P. booklet which will describe how advertising is being used to solve current problems and expand future markets. Send for it.

THE ASSOCIATED BUSINESS PAPERS
369 Lexington Ave., N. Y. C.
Phone CAledonia 5-4755

Clip this coupon to your letterhead and mail to ABP, 369 Lexington Ave., N. Y. C., Dept. A.

☐ **"HOW TO FIND OUT WHAT TO SAY IN YOUR BUSINESS PAPER ADVERTISING TODAY"** Described above . . . ready soon.

☐ **"MR. PRESIDENT: MEET YOUR ADVERTISING MANAGER"** Booklet: Is the nature of a private consultation on the sort of a man the advertising manager is; what he is really worth; how to get the most out of him.

☐ **"HOW I HAMSTRUNG MY ADVERTISING AGENCY"** The confession of a business man who found out how to get a real money's worth from his agency's copywriting skill.

Load Factors Must Rise —and Quickly

[*Continued from page 62*]

Similar conversion programs can be, and have been, set up on a local basis, with a variety of small industries pooling their resources, and even on a single plant basis. Up to now, much of the activity in this direction has been haphazard and ineffective. Signs now point to an increasing emphasis on this type of campaign as the drive to provide materials for expanded war production cuts more heavily into civilian production.

Conversion of these facilities not only "gets more with what you have." In most cases it means longer use of energy to operate the facilities, because war production can be kept on a 'round-the-clock basis.

•

Will Make Tank Equipment

Defense Plant Corporation has authorized the execution of a contract with Blaw-Knox Co., Union Steel Castings Division, Pittsburgh, Pa., to provide for construction and equipping of a plant at Pittsburgh, at a cost of $1,740,200, to be used in the production of military tank equipment.

•

Awards Cable Contracts

Los Angeles Water and Power Commission, Los Angeles, Calif., has divided an award for lead-covered cable of various types among five companies, as follows: General Electric, $44,989 (Items 1, 6 and 18); General Cable, $83,887 (items 3, 5, 7, 8, 16 and 19); Okonite-Callender, $40,476 (items 4, 17, 20 and 21); Phelps-Dodge Copper Products, $19,476 (Items 9 to 15, inclusive), and John A. Roebling's Sons, $19,185 (item 2) (Specifications 3,962).

•

New Gear Shop Started

Erection of a new $16,000,000 shop at the Lynn River works that will add 300,000 sq.ft. of floor space to General Electric's facilities for manufacturing reduction gears for the propulsion sets of Maritime Commission ships is officially under way. The building is being financed with DPC funds.

SEARCHLIGHT SECTION

(Classified Advertising)

Employment : : Equipment
Business : : Used or Resale
"Opportunities"

UNDISPLAYED RATE

10 CENTS A WORD. MINIMUM CHARGE $2.00

Positions Wanted (full or part time salaried employment only), ½ the above rates payable in advance.

Box Numbers—Care of publication New York, Chicago or San Francisco offices count as 10 words.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

DISPLAYED RATE

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $6.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column. 3 columns—30 inches—to a page.

POSITIONS VACANT

ELECTRICAL ENGINEERS: Excellent opportunity for recent graduates in electrical engineering to assist in technical studies and design work, with good opportunity for development into more responsible positions. Large engineering and consulting organization in New York City. Give full particulars, age, education, previous experience if any, and salary expected. P-992, Electrical World, 330 W. 42nd St., New York, N. Y.

DRAFTSMEN: Electrical designers preferably experienced power plant and substation. In reply give age, experience and salary expected. P-993 Electrical World, 330 W. 42nd St., New York, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 32 years' recognized standing and reputation carries on preliminary negotiations for positions of the calibre indicated above through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R.W. Bixby, Inc., 262 Delward Bldg., Buffalo, N. Y.

EXECUTIVES AND TECHNICAL MEN, Qualified candidate desiring $2,500 to $20,000 position may contact employers through our confidential services, established 26 years. The National Business Bourse, 20 W. Jackson Blvd., Chicago.

POSITIONS WANTED

MANAGER OR SUPERINTENDENT—electric, gas, water, ice, heating utilities. Long and successful experience both large and small properties. Organizing, public relations, load building, operating plants all classes, etc. Eight years present connection. References. Take full responsibility reasonable notice, and get results for you. Not subject to draft. PW-994, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

CIVIL ENGINEER, with 16 years experience in design and construction of Electric Transmission and Distribution Lines, Substations, Power Plants, Earth Dams, Concrete Buildings, and Highways. Now employed, desires change. PW-995, Electrical World, 330 W. 42nd St., New York, N. Y.

Your inquiry will have special value . . .

If you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but more important, it will identify you as one of the men the advertiser wants to reach with his message.